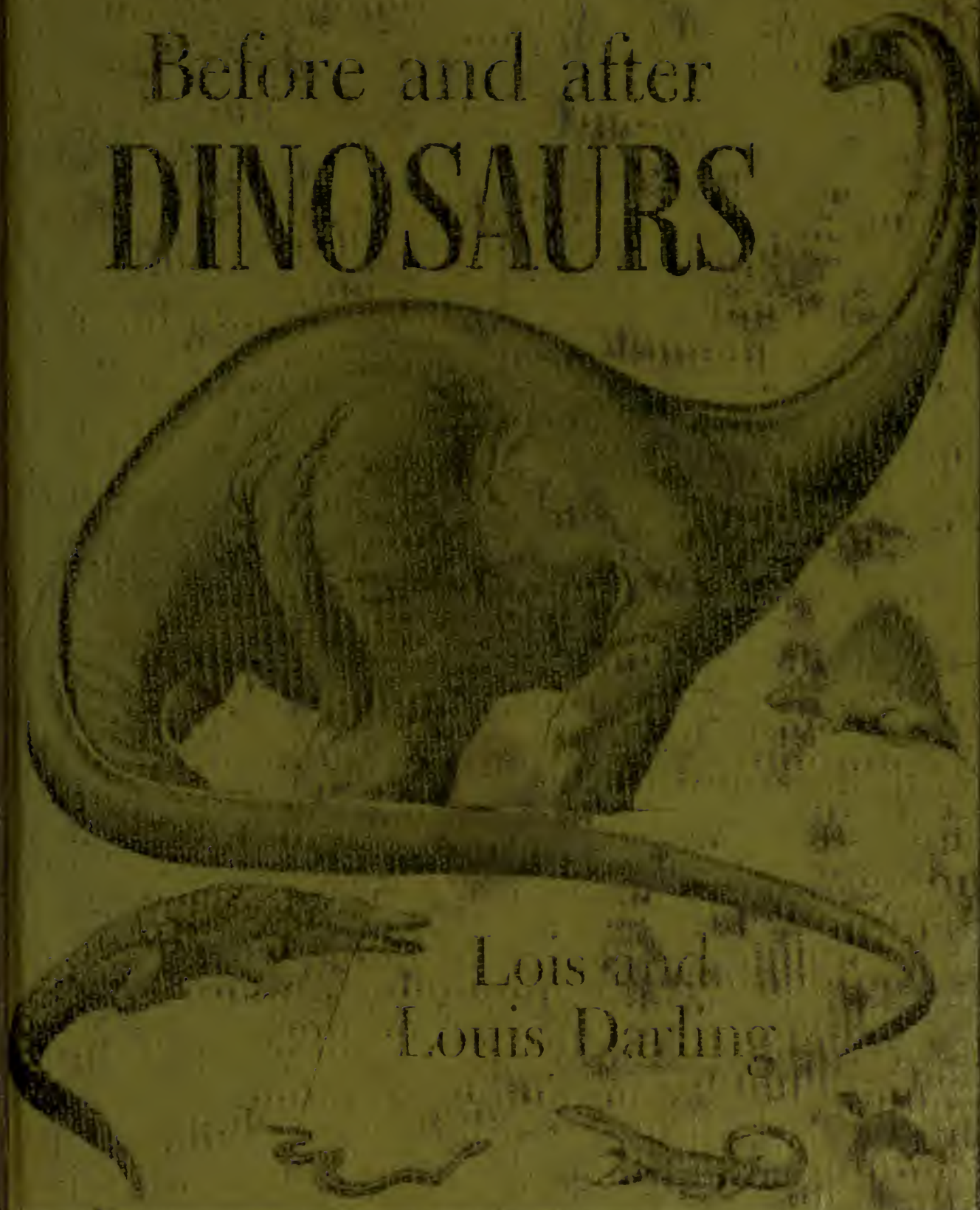


Before and after
DINOSAURS

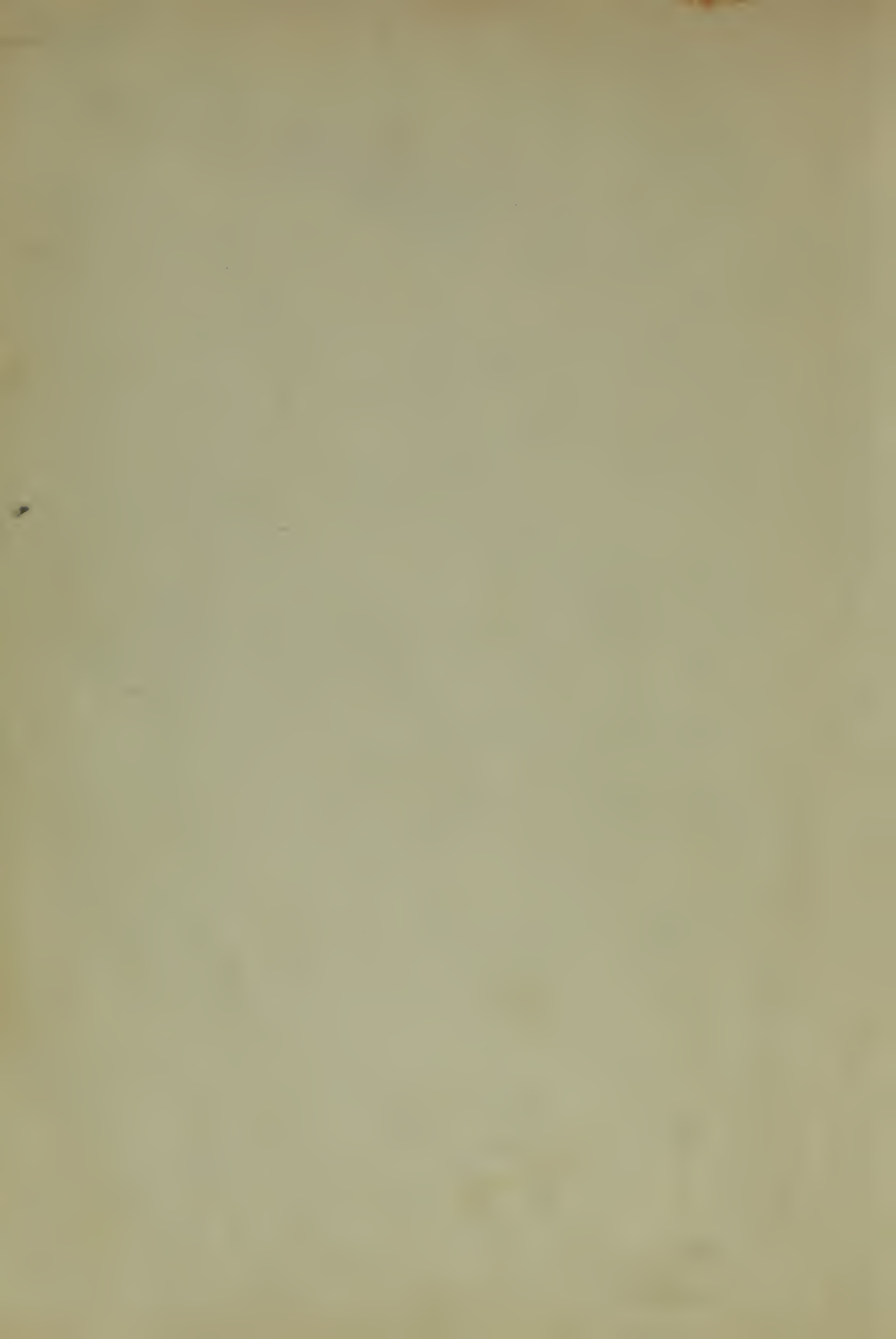
Lois and
Louis Darling

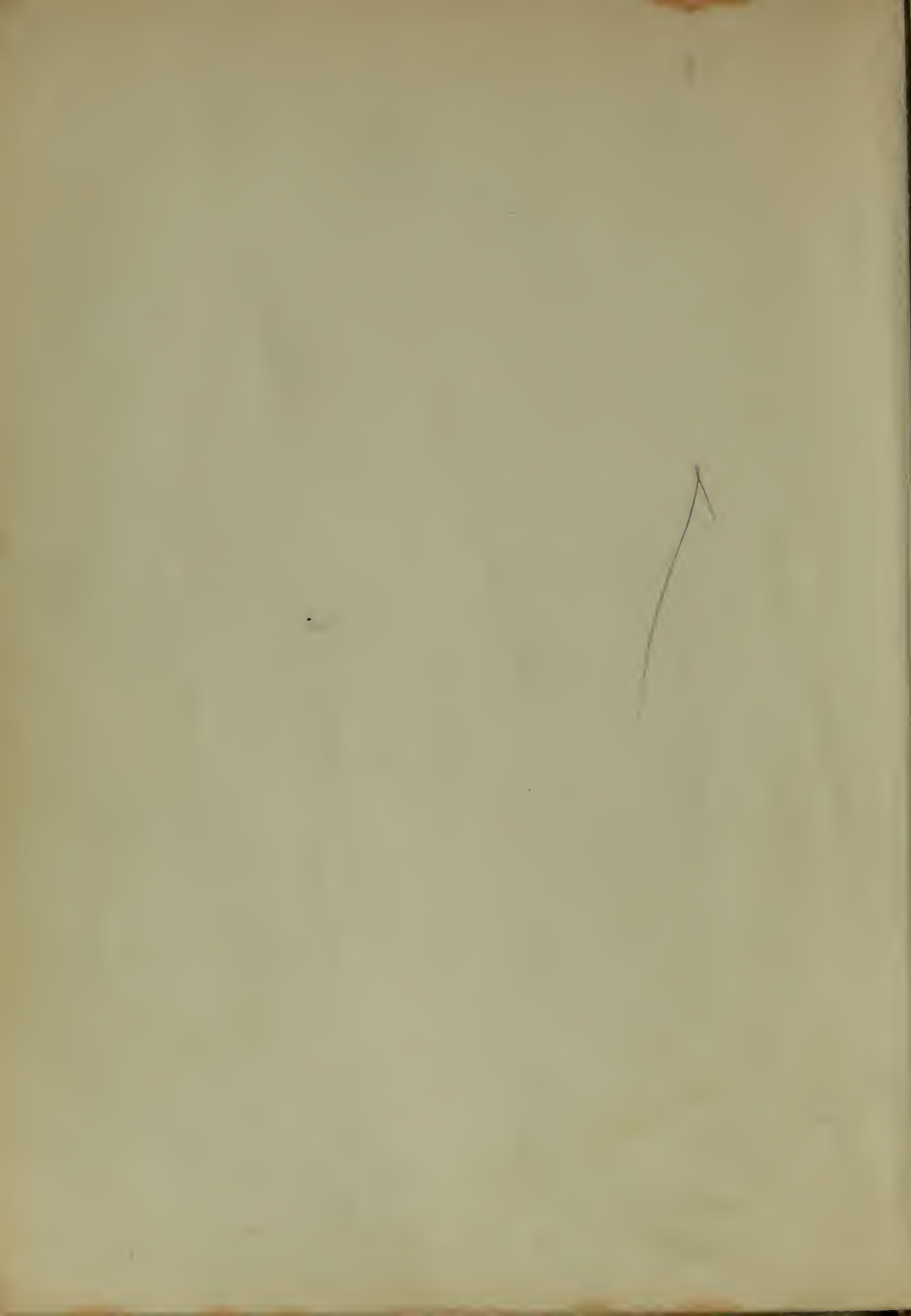


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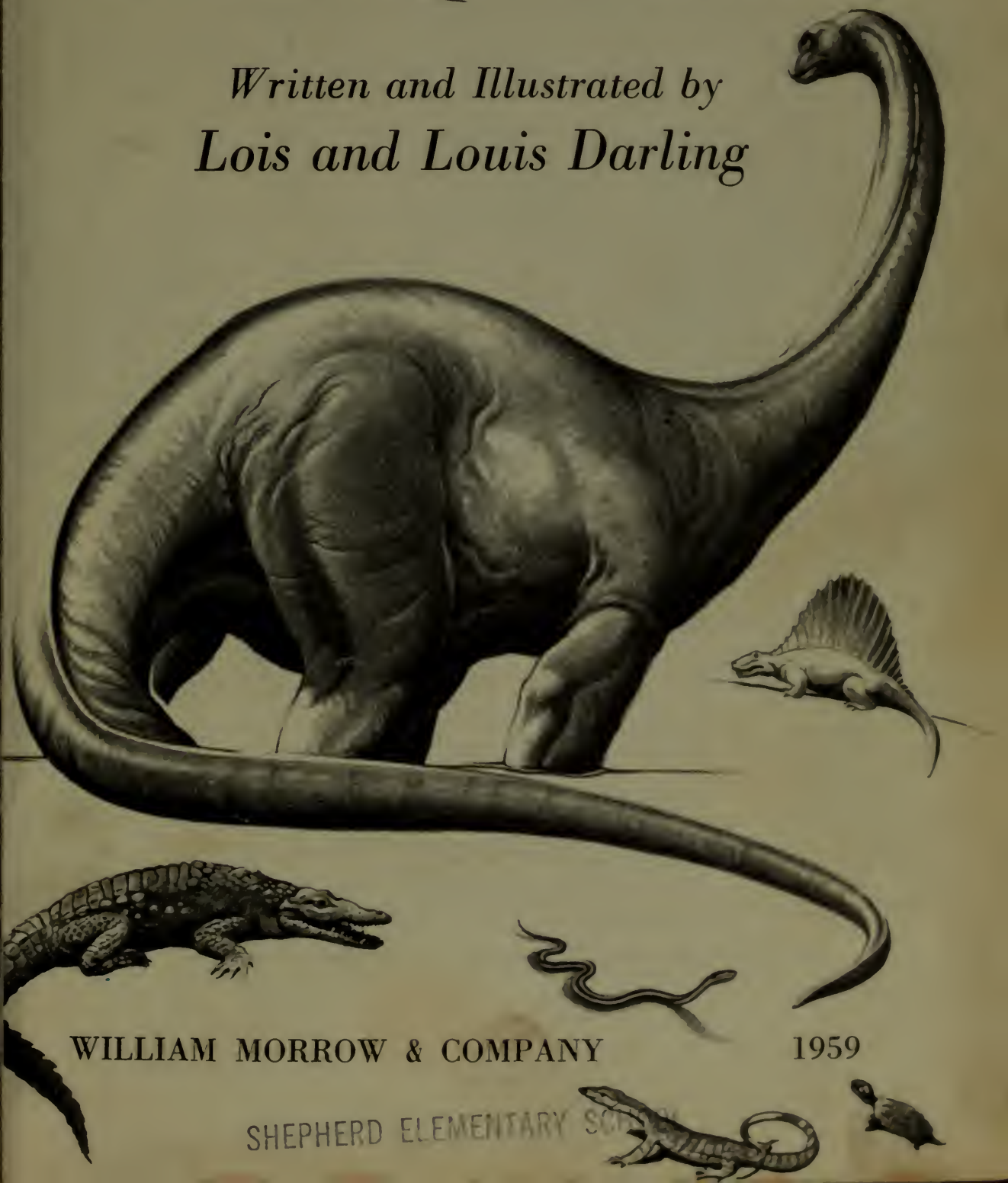
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Before and After DINOSAURS

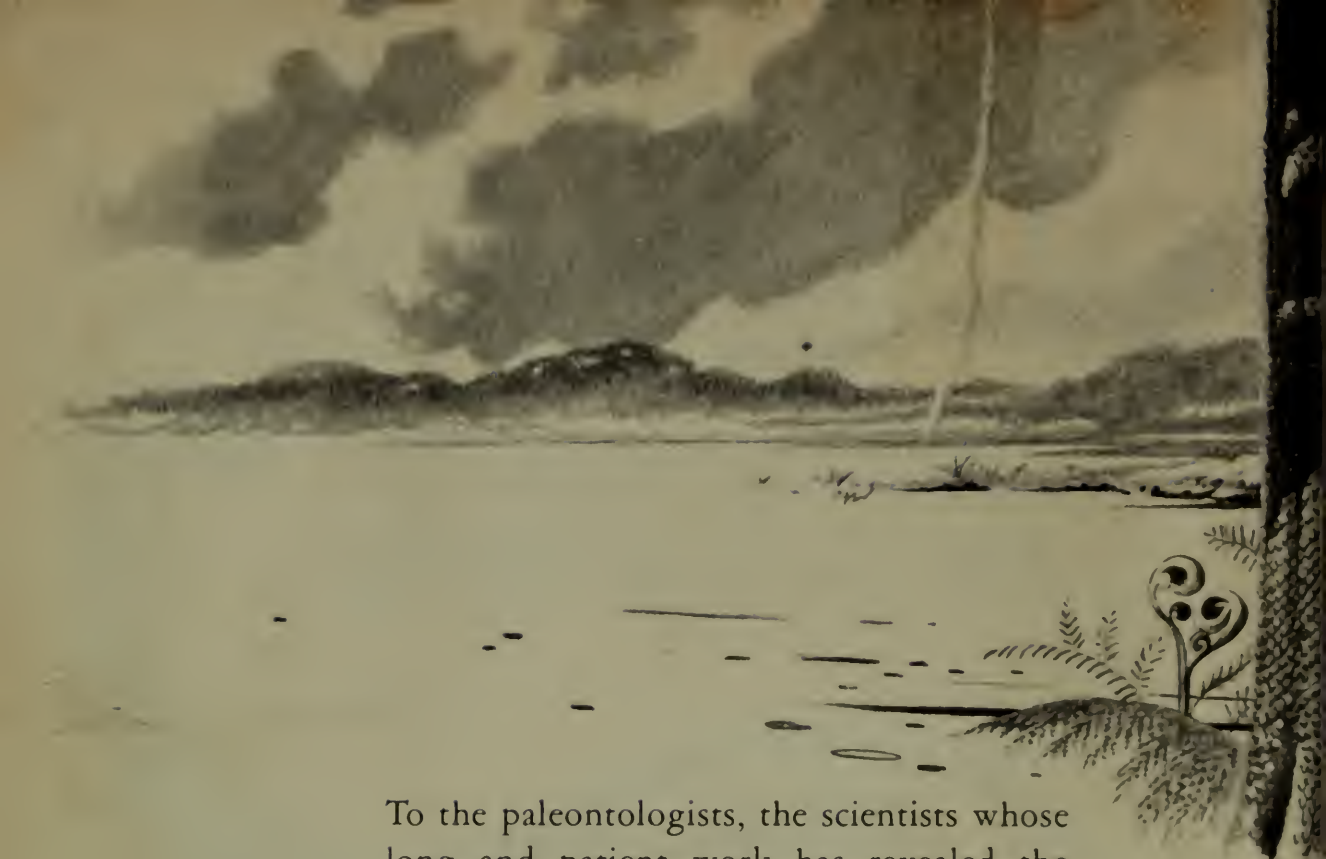
*Written and Illustrated by
Lois and Louis Darling*



WILLIAM MORROW & COMPANY

1959

SHEPHERD ELEMENTARY SCHOOL



To the paleontologists, the scientists whose long and patient work has revealed the facts and the wonder of changing life.

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Dominion of Canada by George J. McLeod Limited,
Toronto. Printed in the United States of America.
Library of Congress Catalog Card Number 59-9439



If you went back in time about two hundred and seventy-five million years and looked out over the land, you would see a strange scene. The earth was not as mountainous then as it is today. The plants, too, were different. There were huge tree ferns, horsetails, scale trees, and leafless plants. Much of the land was swampy, and other large areas were covered by the sea. The climate was moist, warm, and much the same over most of the world.

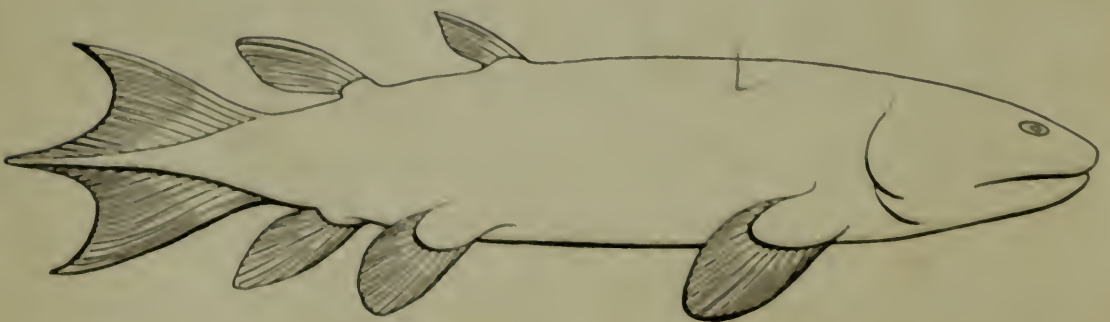


Even stranger than the plants and endless swamps were the animals which inhabited the land. You might see many of the early ancestors of today's hordes of animals without backbones—great dragonflies and other insects, spiders, snails, and many others. But the only land animals with backbones, the vertebrates, were slow creatures, which looked a bit like salamanders. Some of them were only a few inches long, but others were as big as crocodiles.



They might slither into the water as you came near them. Or perhaps they would only stare at you and ignore you altogether. No other animals stirred above the surface of the water. There were no snakes, lizards, birds, or mammals, nothing but these sluggish animals which looked as if they did not quite belong on the land at all. But, of course, no person ever saw this ancient world. No human beings existed yet.

These long-ago salamanderlike creatures were the first animals with backbones to come out of the water and walk on the land. Their fossil skeletons have been found in various places throughout the world. They are called amphibians, because they could live in the water and on the land. These animals had slowly evolved from certain fishes which had developed air-breathing lungs and whose lobe fins had a bony skeleton different from those of other fishes living at the same time. These bony fins became the legs which made it possible for the amphibians to walk.



LOBE - FIN FISH



FIRST KNOWN AMPHIBIAN



A MORE ADVANCED AMPHIBIAN



Salamander egg mass

The coming of the amphibians was a tremendously important event in the history of life. They were the early ancestors of the frogs, toads, and salamanders of today. Their first step out of the watery world resulted in all the uncountable billions of four-footed or two-footed, backboned animals that have lived ever since. The amphibians were not entirely independent of the water. They had to return to the water to lay their eggs. The eggs had to develop in the water, because their wet jellylike coating did not protect them from drying out when exposed to the air.



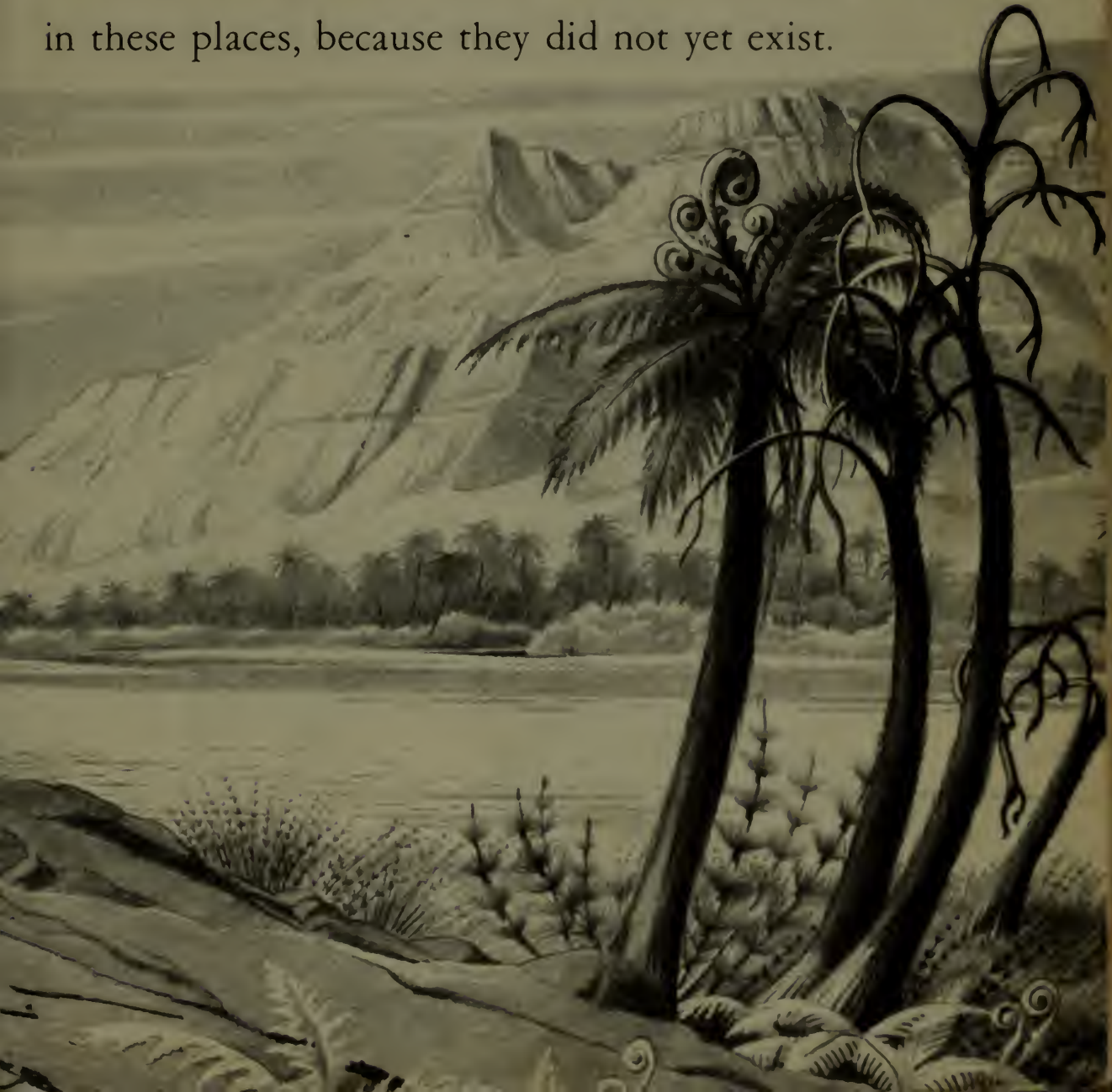
FAMILY TREE OF VERTEBRATES

All vertebrates (animals with backbones) can be separated into these few great classes.

Millions of years after the amphibians had appeared and multiplied, another big event took place in the history of vertebrate life. While much of the land was still swampy and moist, a good deal of it was quite dry. As millions more years went by, more and more dry-land areas appeared. Amphibians could not live in these places, because they needed



water in which to lay their eggs. These large areas of the earth, covered with plants and inhabited by all sorts of small animals without backbones, could provide space and food for large animals with backbones if they needed no more than an occasional drink of water. But no such vertebrate animals lived in these places, because they did not yet exist.



It is a rule of nature that living things come to live in every place that will possibly support some kind of life. This is why uncountable billions of different plants and animals inhabit every bit of the world from deep oceans to the tops of high mountains. All through the long history of life on earth living beings have changed so that they could live in many different ways in many different places. These changes that take place in living things are called evolution.





Since we are human beings, we think about things in a human way. When we talk about evolution, we often speak as though animals and other living things meant to change, because we are used to doing things *on purpose*. Of course, no animal could ever change itself or its offspring on purpose.

Everyone knows that no two living things are ever *exactly* the same. An animal has some features inherited from its father, some from its mother, and some that are entirely new. Most of these differences are very small, sometimes too small to be detected, and they are inherited quite by chance, like the chance which decides heads or tails in the flipping of a coin.



If an animal has some new feature that increases its chance to survive, it will also increase its numbers more than others like it that do not happen to have this feature. These new features are called adaptations. The main adaptations which made it possible for fish to evolve into amphibians were air-breathing lungs and land-walking legs. Before vertebrate animals could inhabit inland places, they had to make the adaptation of laying eggs that could survive on dry land. This change is exactly what happened, and the animals that could lay this new kind of egg were the reptiles.





This new sort of egg did not make it possible for the growing baby inside it to get along without water. Instead, the egg, protected by a hard, leathery shell, held the needed watery surroundings inside it.

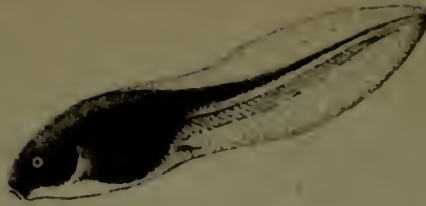
These eggs are called amniote eggs, and all reptiles are still hatched from them. Birds, which in their turn descended from reptiles, are also hatched from this kind of egg. A sac inside the amniote egg, the amnion, holds the liquid which protects the growing life. The amniote egg also has a large yoke, which provides food for the baby reptile before it hatches. It is able to grow more fully in its egg, therefore, than amphibians and fishes can grow in their small-yolked eggs. Reptile babies look much like their parents when they hatch. Young amphibians, however, have to go through a long stage of growth as larvae before they become fully developed. The young of frogs, one of the amphibians that exist today, are, of course, tadpoles, and they are very different from their parents.



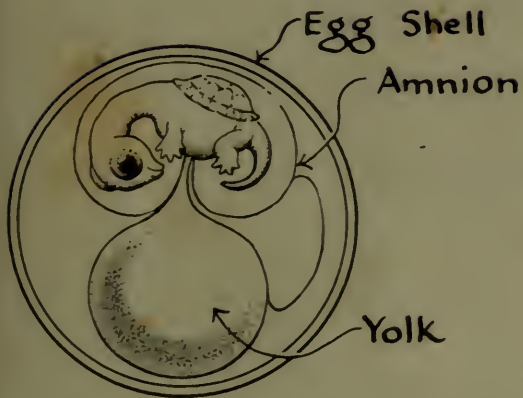
AMPHIBIAN EGG



TADPOLE



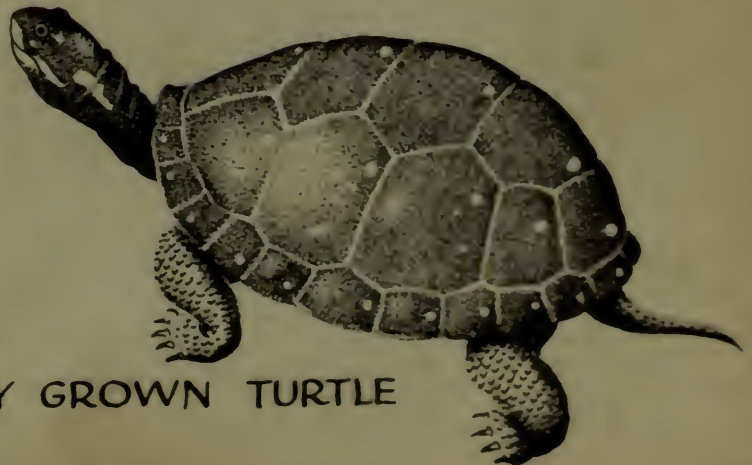
FROG



AMNIOTE EGG



HATCHLING TURTLE



FULLY GROWN TURTLE

So, as the amphibians slowly developed from their fishy ancestors, the reptiles developed from amphibians. The reptiles, in their turn, were a still newer sort of animal, with many new adaptations which made it possible for them to exist where no vertebrate animals had ever existed before. This story is about the five great subclasses of the Class Reptilia that evolved from the first backboned land animals, the amphibians. It is the story of a tremendous flowing of life through the ages. Some parts of this story have led to extinction, for certain kinds of animals died out forever. Other kinds have gone on through the years, and they have developed into the animals we know today—animals such as turtles, chameleons, robins, foxes, rabbits, deer, and you yourself.

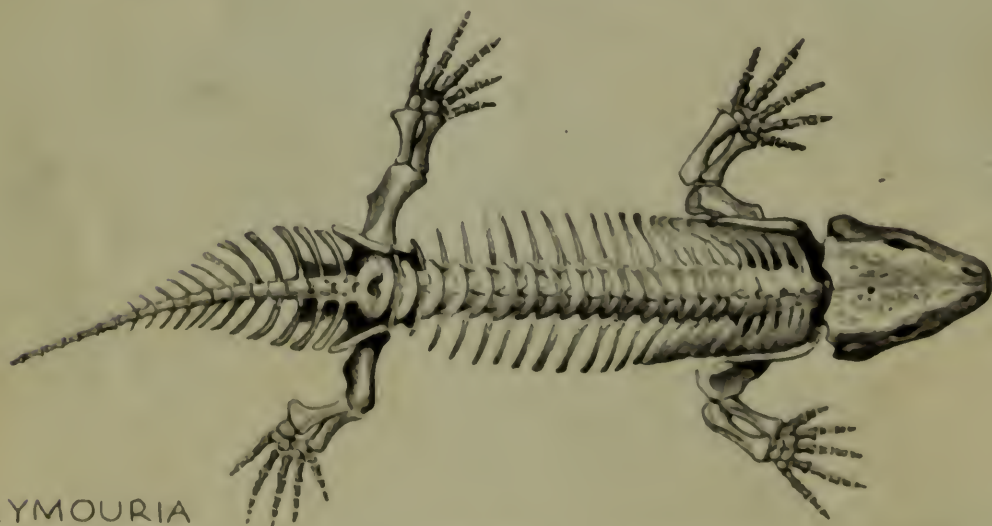




These first reptiles lived at the beginning of the Permian period. Just as fossils have been found of animals which were almost halfway between fishes and amphibians in development, fossils have also been found of animals halfway between amphibians and reptiles. A good representative of these early reptiles is *Seymouria*, which was given this name be-



EARLY AMPHIBIAN



SEYMOURIA
24 inches long

Strong hip, backbone, and shoulder
allow better walking.

cause its fossil skeleton was first found near the town of Seymour, Texas. *Seymouria*'s skull and teeth are much like those of the long-ago amphibians. The rest of its skeleton is more like that of the reptiles. The *Seymouria* fossil is but one of many different types that show plainly how slow gradual changes take place in living things.



SEYMOURIA -reconstructed from
its skeleton

GEOLOGIC TIME SCALE

MILLIONS OF
YEARS AGO

ERAS

PERIODS

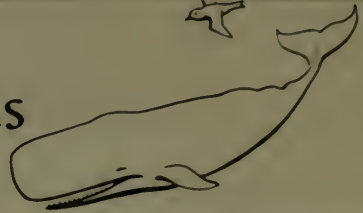
1	CENOZOIC	QUATERNARY
75		TERTIARY
135	MESOZOIC	CRETACEOUS
165		JURASSIC
205		TRIASSIC
230	PALEOZOIC	PERMIAN
280		CARBONIFEROUS
325		DEVONIAN
360		SILURIAN
425		ORDOVICIAN
500		CAMBRIAN
3000+	PRE-CAMBRIAN	

Geologic divisions of time represent the order of events in the history of earth. Each division is determined by certain geologic happenings and certain animals and plants that lived in it.

— NOW —



AGE OF MAMMALS



AGE OF REPTILES



first birds and mammals



coal forests

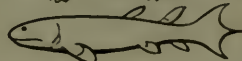
first insects

AGE OF AMPHIBIANS



first reptiles

first amphibians



AGE OF FISHES



first land plants



APPEARANCE OF MANY MARINE INVERTEBRATES



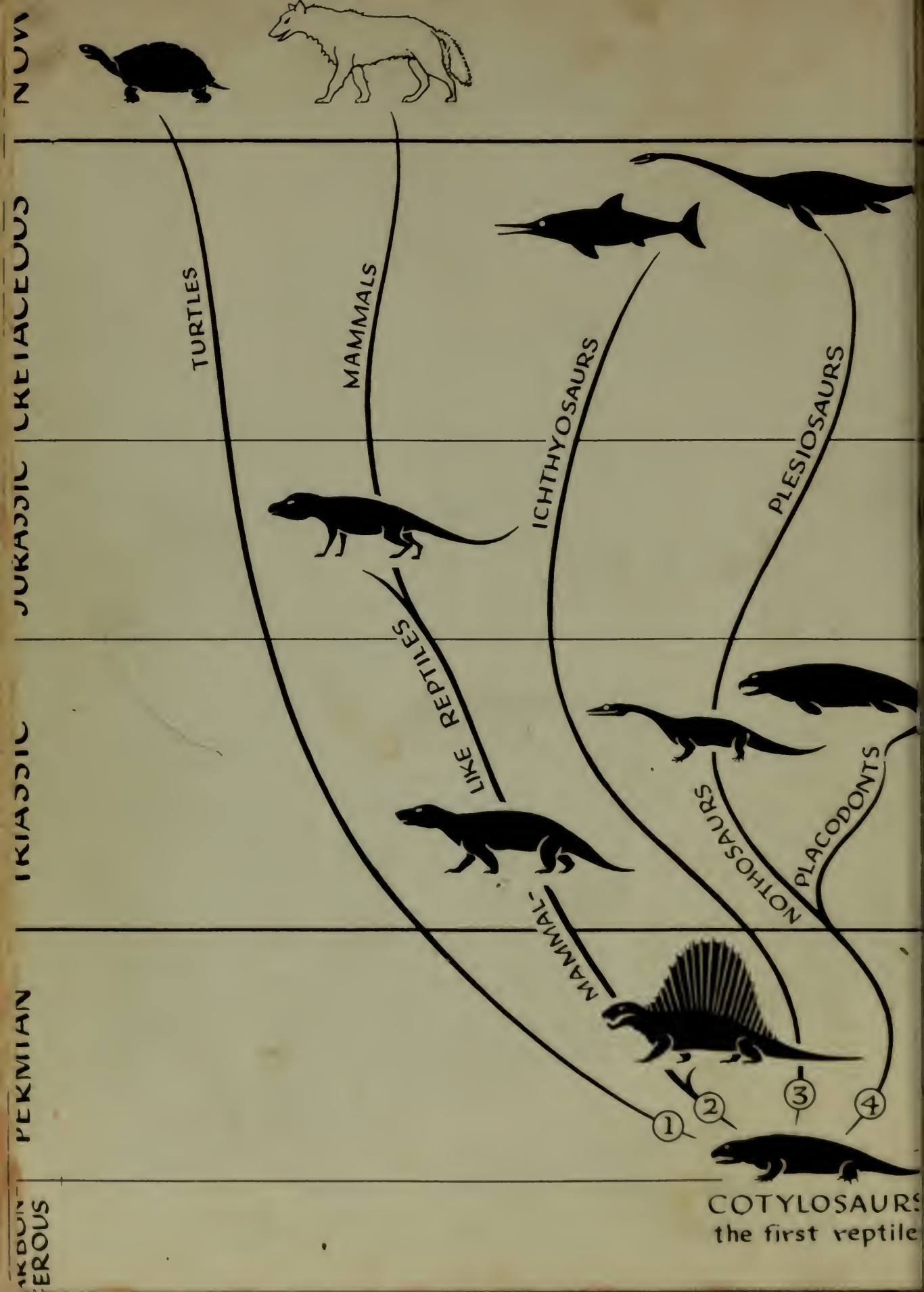
FIRST KNOWN FOSSILS —
algae and microorganisms

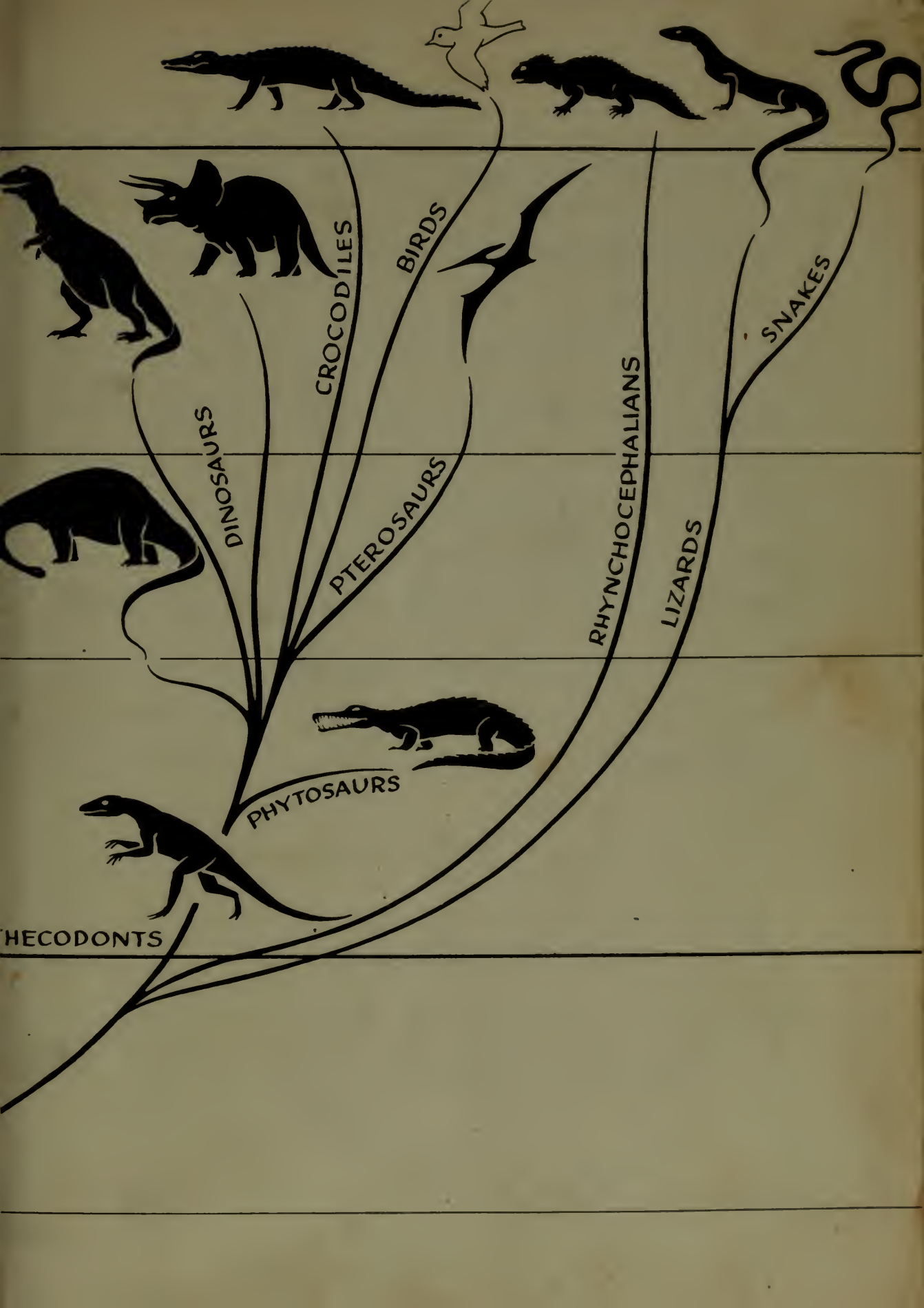
Are animals still changing today? Of course they are; they always have and always will as long as life exists. But these changes take so long that we cannot see them happen. In all the time that men have kept historical records—seven thousand years or more—there has not been enough time to see animals change very much. But in the fossils, which contain a record of life through millions of years, we find clear proof that these tremendous changes do take place.

Seymouria was a member of the first order of true reptiles from which all others have descended. These reptiles are called cotylosaurs (kŏt' ỹ lŏ sŏrs). (For the pronunciation of this name and other animal names see pages 94-95.) But like all else that lives, cotylosaurs slowly began to change as millions of years rolled by. By Triassic times, five separate branches, or subclasses, of the great Class Reptilia had developed from cotylosaur ancestors.

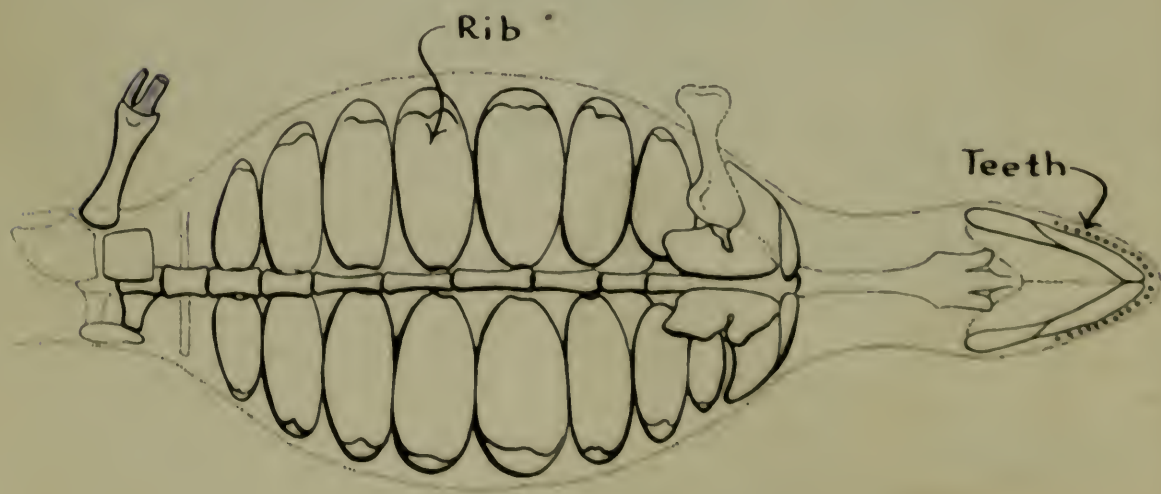


Many fossils are found embedded in layers of rock which were once muddy deposits of silt on the bottoms of rivers, lakes, and seas millions of years ago.





The turtles are in one of these five subclasses. Not very much is known about their early history, because they did not leave many fossil remains, or, at least, we have not found many. There is one small bit of a fossil, however, which does give us a hint of how they developed. It was found in South Africa in rock which originated in Permian times. The ribs of this small reptile were broadened and touched each other, forming an almost solid layer of bone. While this fossil probably does not represent the direct ancestor of turtles, special ribs of this kind may well have been a step in the evolution of the turtle shell.



The first real turtles, judging by the fossil record in rocks, probably appeared during the middle of the Triassic period. These turtles still had a few teeth like their cotylosaur ancestors, and they probably could not draw their head and legs beneath their shell. Otherwise, they were much like modern turtles.

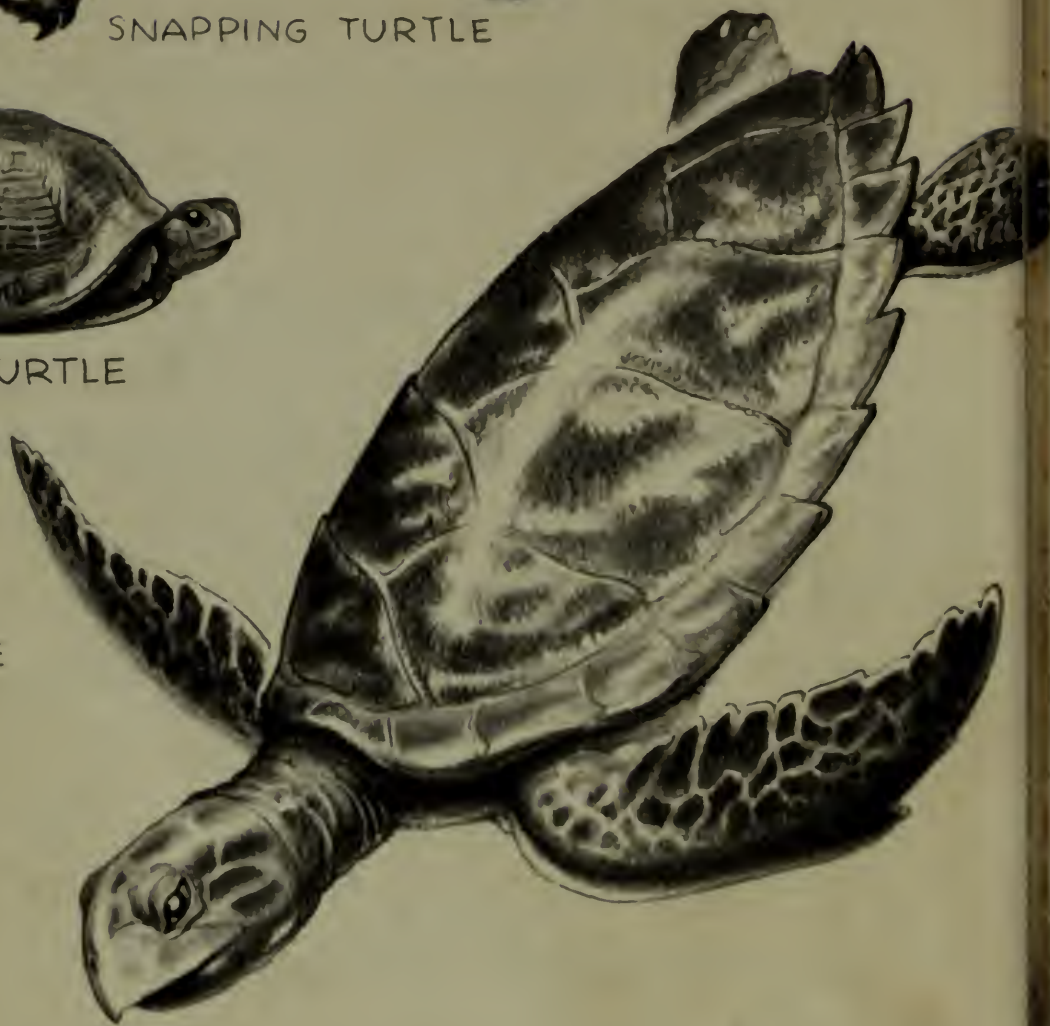
As this story of the reptiles develops, you will see that the way in which the different kinds of reptiles walked, ran, and moved about had a very important effect on their evolution. But the turtles kept the awkward, short, sprawling legs that their reptile ancestors had. Tucked safe inside their tanklike armor plate, they did not need to run fast or fly. Today turtles are plentiful and widely spread over the earth. Some live in the sea, some in fresh water, and some on land. Some eat meat, some vegetation, and some eat both. Some are very, very small, while others, like the Galapagos tortoises, are giants.



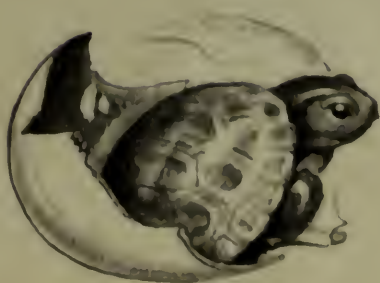
SNAPPING TURTLE



BOX TURTLE



SEA TURTLE

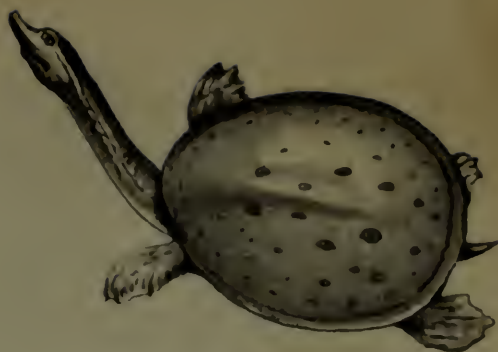


HATCHLING





POTTED TURTLE



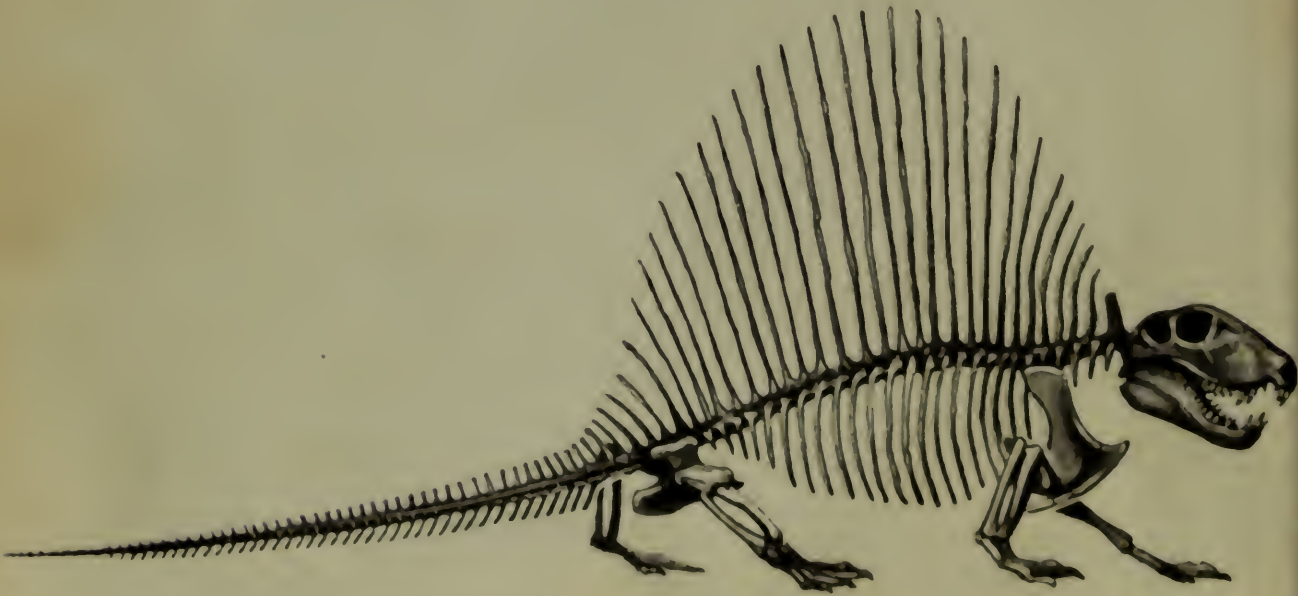
SOFT-SHELLED TURTLE



GALÁPAGOS TORTOISE

The ancestors of the great Class Mammalia are included in another reptile subclass. These animals are very important to us, since we belong to the mammal class. If it were not for these long-ago cold-blooded reptiles, we would not be living. Slowly, slowly, through millions of years, these reptiles became less and less like their cotylosauri ancestors and more and more like mammals.

The pelycosaurs were very early mammal-like reptiles. Many fossil skeletons of them have been found in Texas, New Mexico, and Oklahoma. They looked



FOSSIL PELYCOSAUR



rather like large lizards at first, but some of the later pelycosaurs developed a very strange feature. The spines of the vertebrae grew to a tremendous length and supported a web of skin, which looked like a sail, all along the back. No one has yet been able to find out what was the purpose of this spectacular bit of anatomy. Some pelycosaurs were large meat eaters with dagger teeth and wide-opening jaws. Others were plant eaters, and their teeth had become adapted into a broad, blunt shape, good for chewing tough plants.

The therapsids were pelycosaur descendants. They lived during the Permian and Triassic periods. The teeth of early reptiles were sharp, pointed, and all the same. But as these mammal-like reptiles evolved, their teeth became different from each other in different parts of the animal's mouth. They had special teeth for special purposes. The incisor teeth in front were good for nipping, the canines behind them for stabbing, and the molarlike cheek teeth in back for chewing and cutting. We and other mammals have inherited similar teeth.

The legs of the therapsids had become tucked in under their bodies, moving freely backward and forward, so that they could run more efficiently, as a



CYNOGNATHUS SKULL



dog does, instead of waddling over the ground as their early ancestors did. Gradually many other therapsid features became more and more like those of the mammals they would one day evolve into.

A good example of the therapsids was *Cynognathus*, which lived during the early Triassic period. It was about the size of a collie dog and had well-developed incisor, canine, and cheek teeth. The name *Cynognathus* means dog jaw. These special teeth show that *Cynognathus* must have had a more efficient digestion and more energy, and must have been more lively than the average reptile. Many reptiles simply swallow their food whole, so they need a long time to digest it.



AN ICTIDOSAUR

Even closer to mammals was a reptile group called ictidosaur. They are in between reptiles and mammals in much the same way as *Seymouria* is between amphibians and reptiles.

Mammals are more efficient animals than reptiles in many other ways besides their teeth, digestion, and more upright walking position. One of the main adaptations that make them so is the way they reproduce their young. A mammal mother protects

her growing babies inside her body until they are ready to be born. Then she gives them milk and stays with them until they grow old enough to take care of themselves. This is a safer way to reproduce young than laying eggs, as all reptiles do. Today no mammals, except the scarce little platypus of Australia, lay eggs. Even this primitive mammal nourishes its young with milk after they hatch.



The mammals are also more efficient because they are warm-blooded. The reptiles, amphibians, and fishes were, and still are, what we call cold-blooded. These terms, warm and cold, are not very good ones to use in describing the temperature of animal blood. A cold-blooded reptile may very well have warmer blood, when it is basking in the sun, than a warm-blooded mammal. What we really mean is that a mammal's temperature stays much the same no matter how warm or cold it happens to be. This is not true of reptiles, amphibians, and fish. Their temperature is much the same as the temperature of the air





or water that surrounds them. In cold weather the cold-blooded animals get more and more sluggish until they do not have enough energy to keep moving. Then they go to sleep until their surroundings warm up. If they get too cold, however, the cold-blooded animals freeze and die. But even in extremely cold weather the body temperature of mammals, with the help of their furry coats, stays the same. Their blood also stays at the same temperature in very hot weather. Reptile blood does not, and sometimes these animals die when they are caught out in the hot sun.

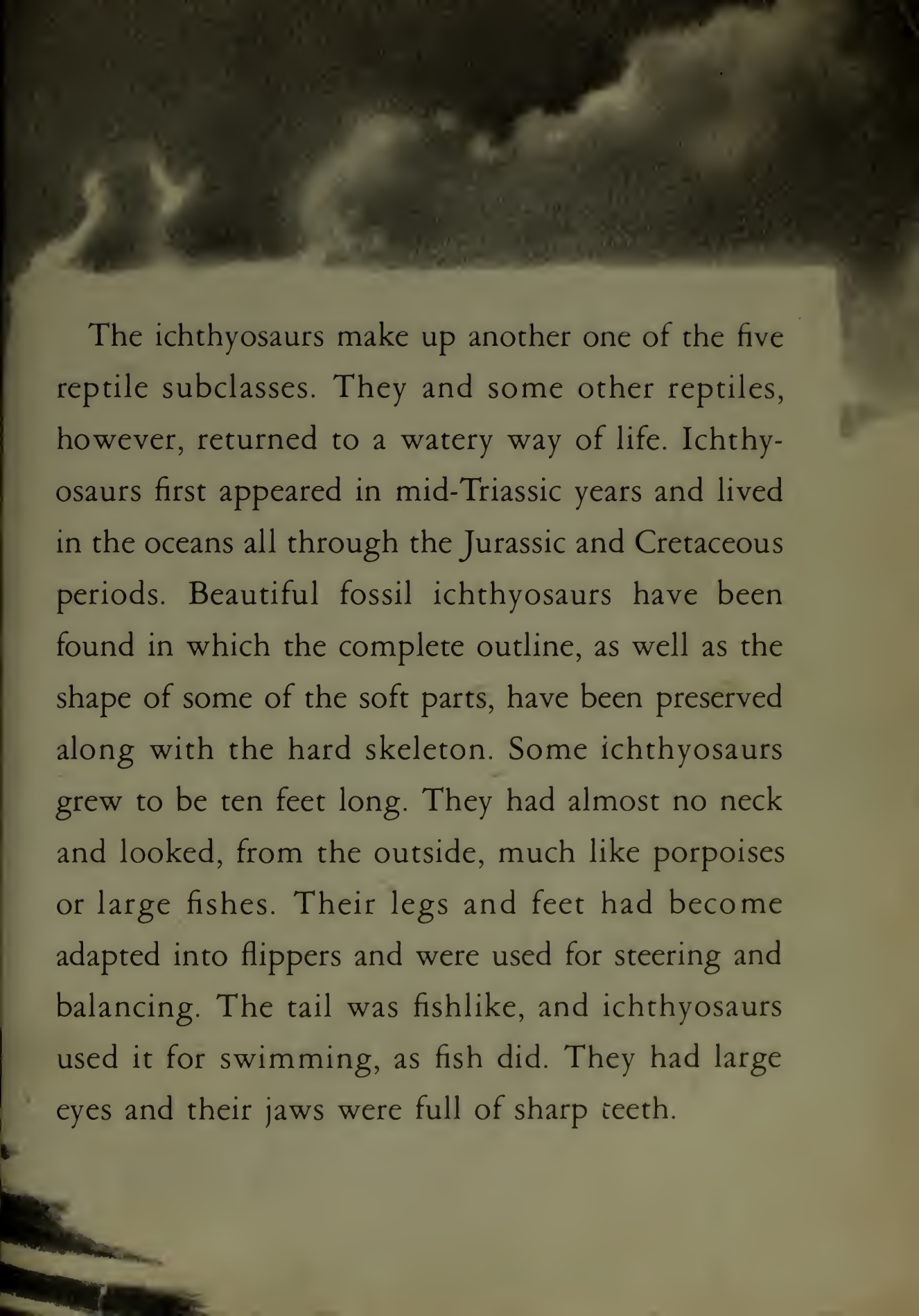
A better circulatory system, an even temperature, the new method of giving birth to living young, the development of larger brains, and many other features new to life on earth made mammals more efficient animals than reptiles. But even after the first real mammals evolved, in the Jurassic period, another hundred million years or so went by before they became important.



ALLOSAURUS
AND
EARLY MAMMALS





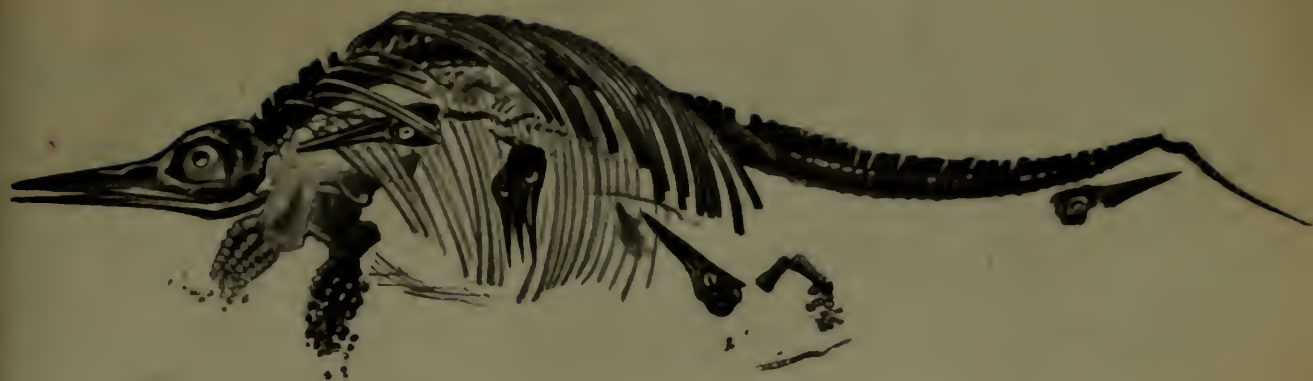


The ichthyosaurs make up another one of the five reptile subclasses. They and some other reptiles, however, returned to a watery way of life. Ichthyosaurs first appeared in mid-Triassic years and lived in the oceans all through the Jurassic and Cretaceous periods. Beautiful fossil ichthyosaurs have been found in which the complete outline, as well as the shape of some of the soft parts, have been preserved along with the hard skeleton. Some ichthyosaurs grew to be ten feet long. They had almost no neck and looked, from the outside, much like porpoises or large fishes. Their legs and feet had become adapted into flippers and were used for steering and balancing. The tail was fishlike, and ichthyosaurs used it for swimming, as fish did. They had large eyes and their jaws were full of sharp teeth.

The ichthyosaurs were so changed, as they became adapted to a water life, that it would have been impossible for them to live on land as their ancestors had done. They would have been as out of place as a porpoise on land. Yet in both cases the ancestors of these animals were walking, air-breathing, land animals. When a baby porpoise is born, the first thing the mother does is to push it quickly to the surface so that it can begin to breathe. Ichthyosaurs must have done the same thing. How could their dry-land amniote eggs hatch, however, if



PORPOISE WITH NEWBORN BABY



FOSSIL ICHTHYOSAUR AND BABIES

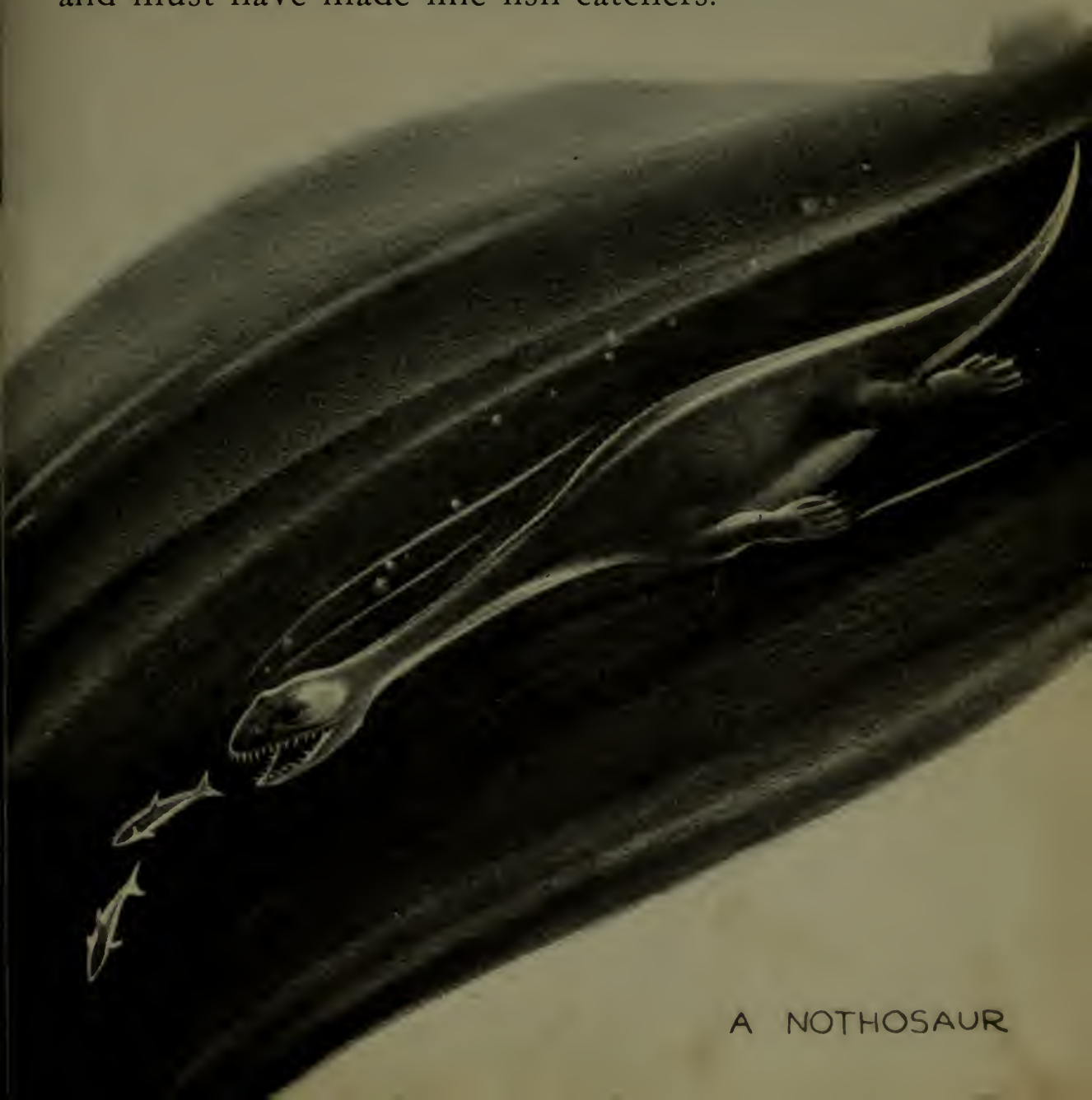
the ichthyosaurs could not get out of the sea to lay them? We would not know the answer to this question if it were not for some ichthyosaur fossils, which show unborn baby ichthyosaurs inside the mother's body. We know these grown ichthyosaurs had not eaten the young ones, for one remarkable fossil shows the babies in the process of being born. The reptilian amniote egg was kept within the mother's body, which protected it from the sea until the babies were born. The large yolk of the egg nourished them during this time.



A PLACODONT

The placodonts, nothosaurs, and plesiosaurs were all included in another one of the reptile subclasses, the sauropterygians. The placodonts lived during the Triassic period. They had heavy bodies, short necks, and paddlelike feet. Their front teeth stuck forward like shovels, and behind them were broad, flat crushing teeth. The placodonts must have cruised along slowly in shallow water, dredging up shellfish with the front teeth and crushing them with the heavy back teeth.

The nothosaurs lived at the same time as the placodonts. They were slim, long-necked reptiles. Their legs and feet look as though they would have been good for walking about on land as well as for swimming. Nothosaur teeth were long and sharp and must have made fine fish catchers.



A NOTHOSAUR

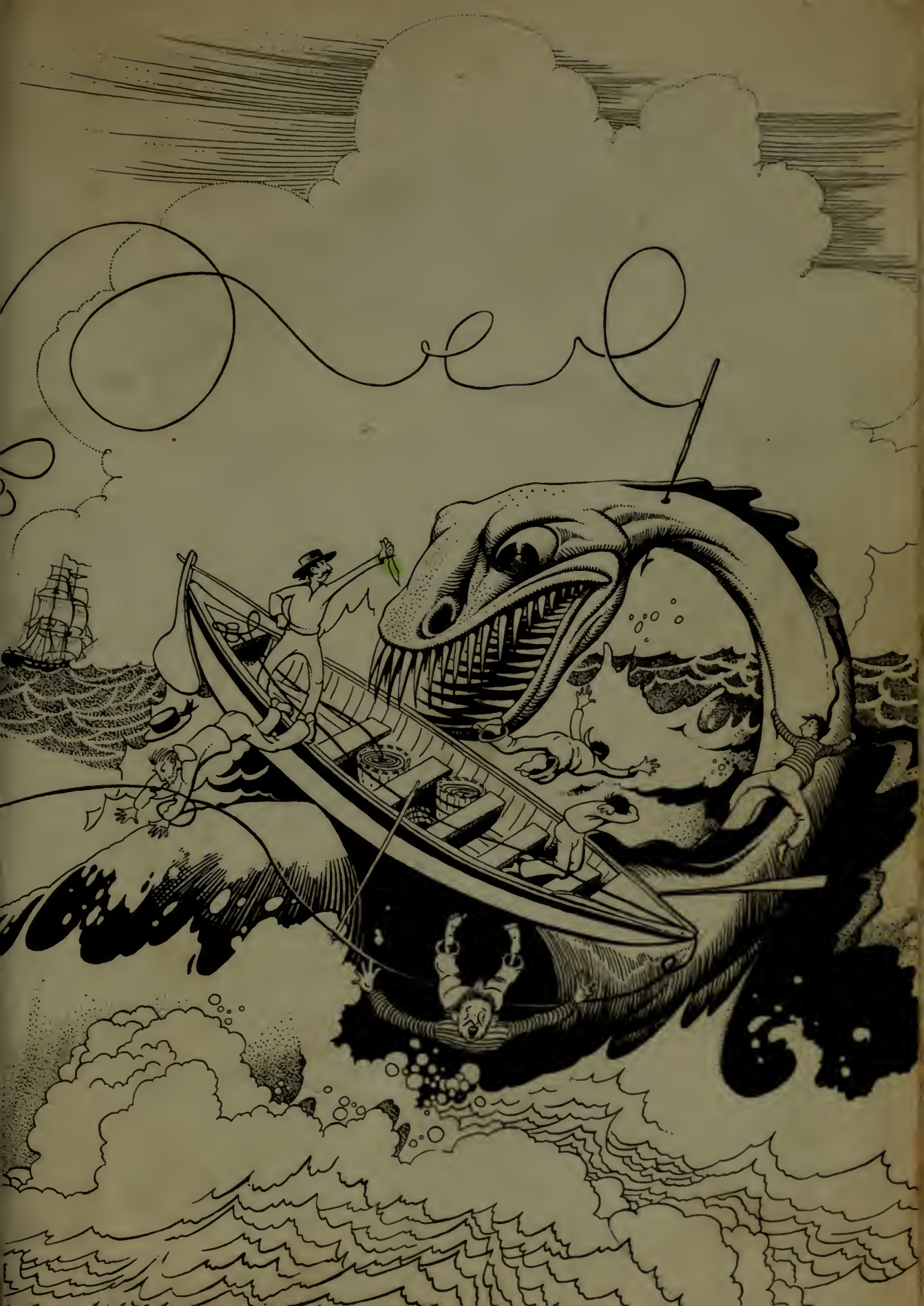
Plesiosaurs must have been fascinating animals. There were long-necked plesiosaurs and short-necked plesiosaurs, big plesiosaurs and bigger plesiosaurs.



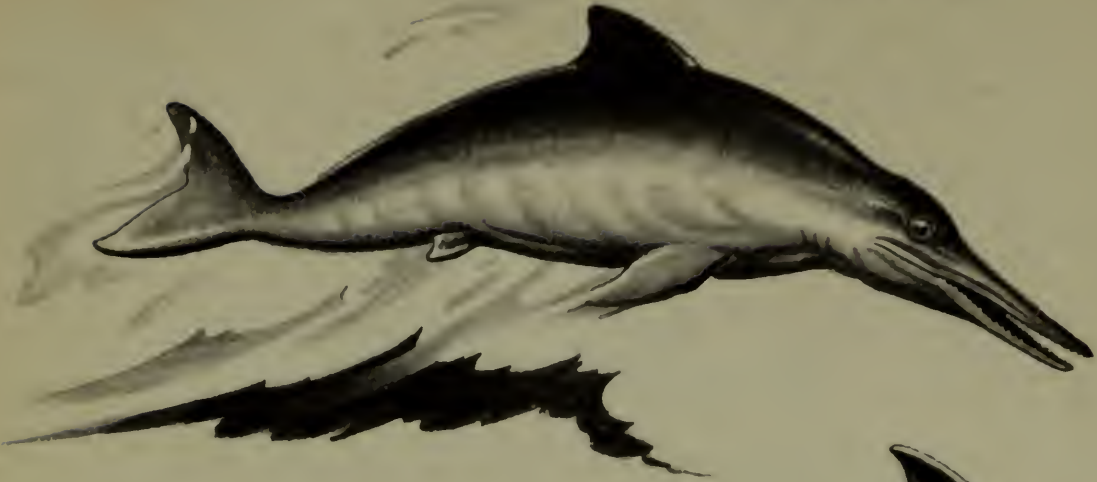


Years ago when crews of sailing ships reported seeing sea monsters, it was thought that a few plesiosaurs might still be left from the Age of Reptiles. This was not true, of course, and the sailors must have seen something else. Even today most imaginary drawings of sea serpents are modeled after the plesiosaurs. These animals lived during Jurassic and Cretaceous times, the periods when most of the ancient reptiles reached their greatest numbers. The later plesiosaurs were nearly fifty feet long; most of their length was neck. Their feet were huge paddles with which they rowed themselves along. At the end of their snakelike necks they had sharp-toothed jaws, which must have made it easy for them to snatch fish from the long-ago oceans they lived in.





AN ICHTHYOSAUR WAS
AN AIR-BREATHING, SEA-
GOING REPTILE



A PORPOISE IS AN
AIR-BREATHING, SEA-
GOING MAMMAL



Ichthyosaurs and sauropterygians became extinct by the end of the Cretaceous period. Today, however, porpoises and dolphins live in much the same way as the ichthyosaurs did long ago. There are also animals today which live as the sauropterygians did—our seals and walruses.

A NOTHOSAUR - REPTILE



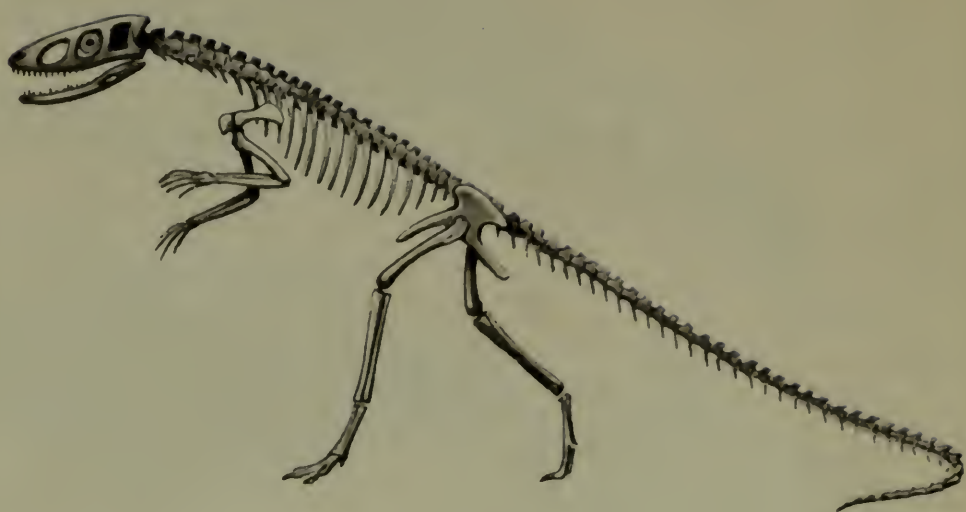
A SEAL - MAMMAL



THE PLACODONT, A
REPTILE, ATE SHELLFISH



SO DOES THE WALRUS — DIGGING THEM



THECODONT

The fifth reptile subclass, which includes ruling reptiles, lived—and many still live—in tremendous numbers and varieties. The dinosaurs were just one of the many groups in this subclass. They had their beginnings in the thecodonts, which were also the ancestors of the crocodiles and the pterosaurs. Thecodonts lived during the Triassic period only. A typical early thecodont was just three feet long, tail and

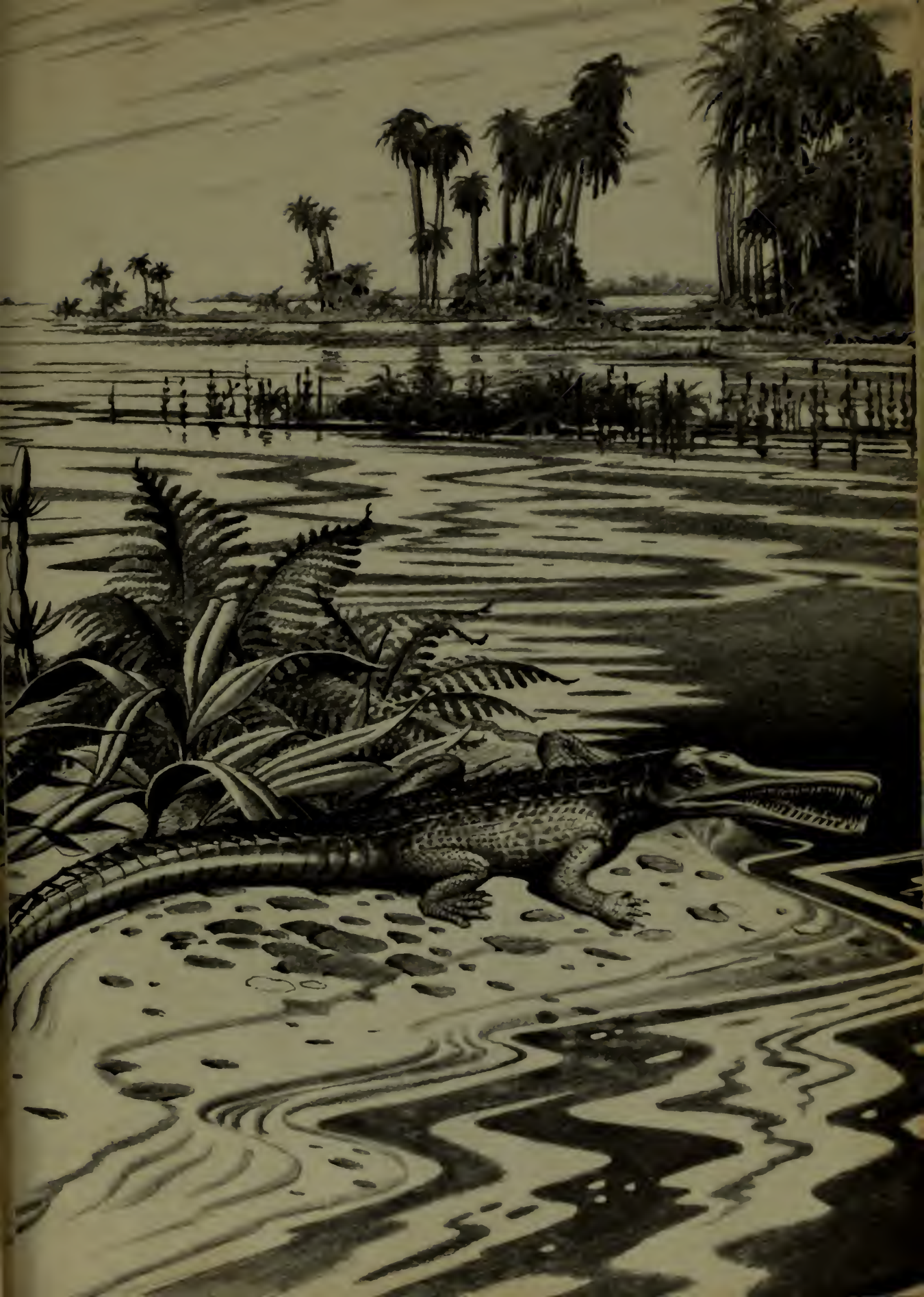


all. An important thing about it was that it could run on its two strong hind legs alone. This two-footed, or bipedal, way of getting about was a new animal feature. The mammal-like reptiles became more efficient animals, because they developed a faster gait when their four legs became tucked in under them. The thecodonts developed a faster gait also, because of their lengthened, strong hind legs.

The phytosaurs, which looked somewhat like crocodiles, were a special kind of thecodont. They led the same sort of lives as crocodiles lead today. They were not as successful as crocodiles, however, because about the same time that the first crocodiles appeared phytosaurs became extinct. Up until that time, though, the phytosaurs had been very numerous animals, and many, many of their fossils have been found.



FOSSIL PHYTOSAUR



The first dinosaurs came along late in the Triassic period. But they did not become the varied and mighty animals we think of as dinosaurs until Jurassic and Cretaceous times. The first known dinosaurs of this large and wonderful group of reptiles were the theropod dinosaurs. *Coelophysis* was a theropod. Many beautiful and complete fossil skeletons of it have been found in late Triassic rocks in New Mexico. *Coelophysis* was a light, hollow-boned reptile. Although it was about eight feet long it weighed only about forty or fifty pounds. Its bipedal way of moving and its entire makeup clearly show that its ancestors were thecodonts.



COELOPHYSIS





Triceratops



Ankylosaurus



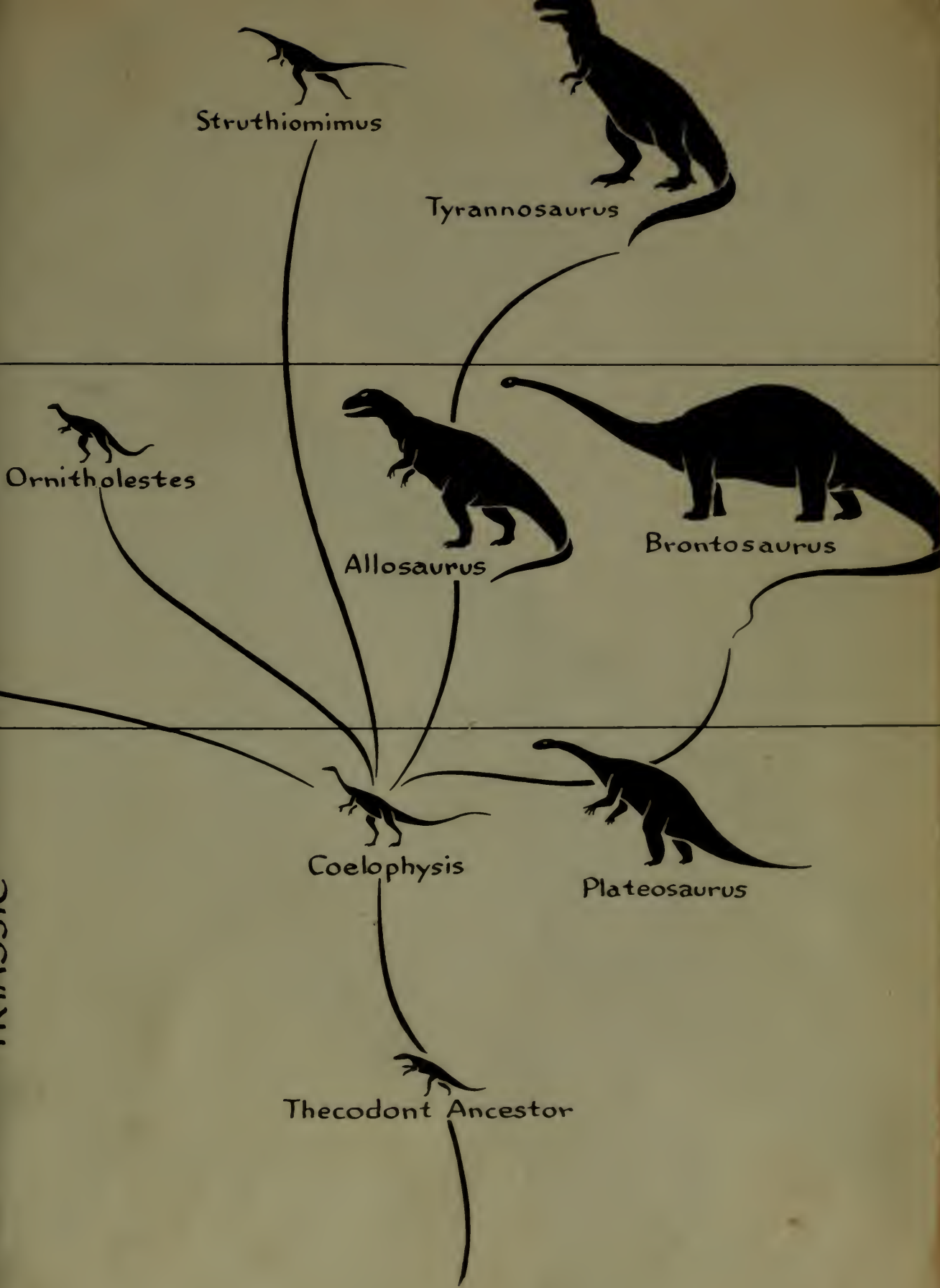
Anatosaurus



Stegosaurus

Another dinosaur of this time was *Plateosaurus*, which was about twenty feet long. It was more massive and heavier than either *Coelophysis* or its thecodont ancestors. It did not have hollow bones, since such bones are not strong enough to support the weight of a creature as big as *Plateosaurus*.

TRIASSIC





ORNITHOLESTES

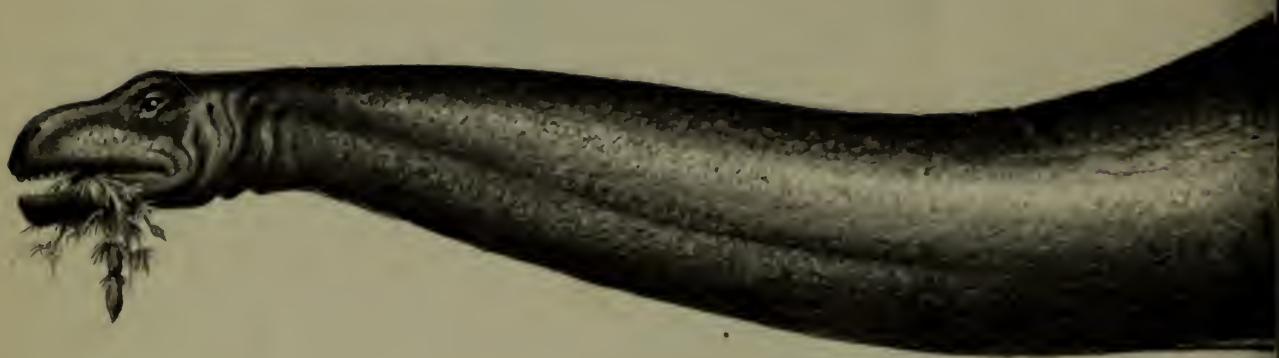


TYRANNOSAURUS



STRUTHIOMIMUS

Meat-eating dinosaurs like *Coelophysis* were the ancestors of dinosaurs such as little *Ornitholestes* and great *Allosaurus*, which lived in the late Jurassic period, and of *Struthiomimus* and mighty *Tyrannosaurus*, which lived in the Cretaceous period.





BRONTOSAURUS

Plant-eating *Brontosaurus*, and its relations, *Diplodocus* and *Brachiosaurus*, grew to be eighty-five feet long and weighed almost one hundred thousand pounds! *Stegosaurus*, *Triceratops*, *Ankylosaurus*, and



TRICERATOPS

the rest of BRONTOSAURUS



STEGOSAURUS



ANKY



ANATOSAURUS
(a duck-billed
dinosaur)

the duck-billed dinosaurs formed another branch of plant-eating dinosaurs, and they were also related to early theropods like *Coelophysis*. These dinosaurs ranged the earth for a hundred million years before they became extinct.

Two more marvelous groups of animals—the flying reptiles (pterosaurs), and the birds, which we know and love so well today—also had thecodont ancestors.

The first pterosaurs evolved in early Jurassic times and continued to live through most of the Cretaceous period. *Rhamphorhynchus* was an example of an early pterosaur. It had a wingspread of about two feet, tiny hind legs, and a very long tail with a paddlelike rudder on the end. Its front legs had developed into wings. A web of skin, perfectly pre-

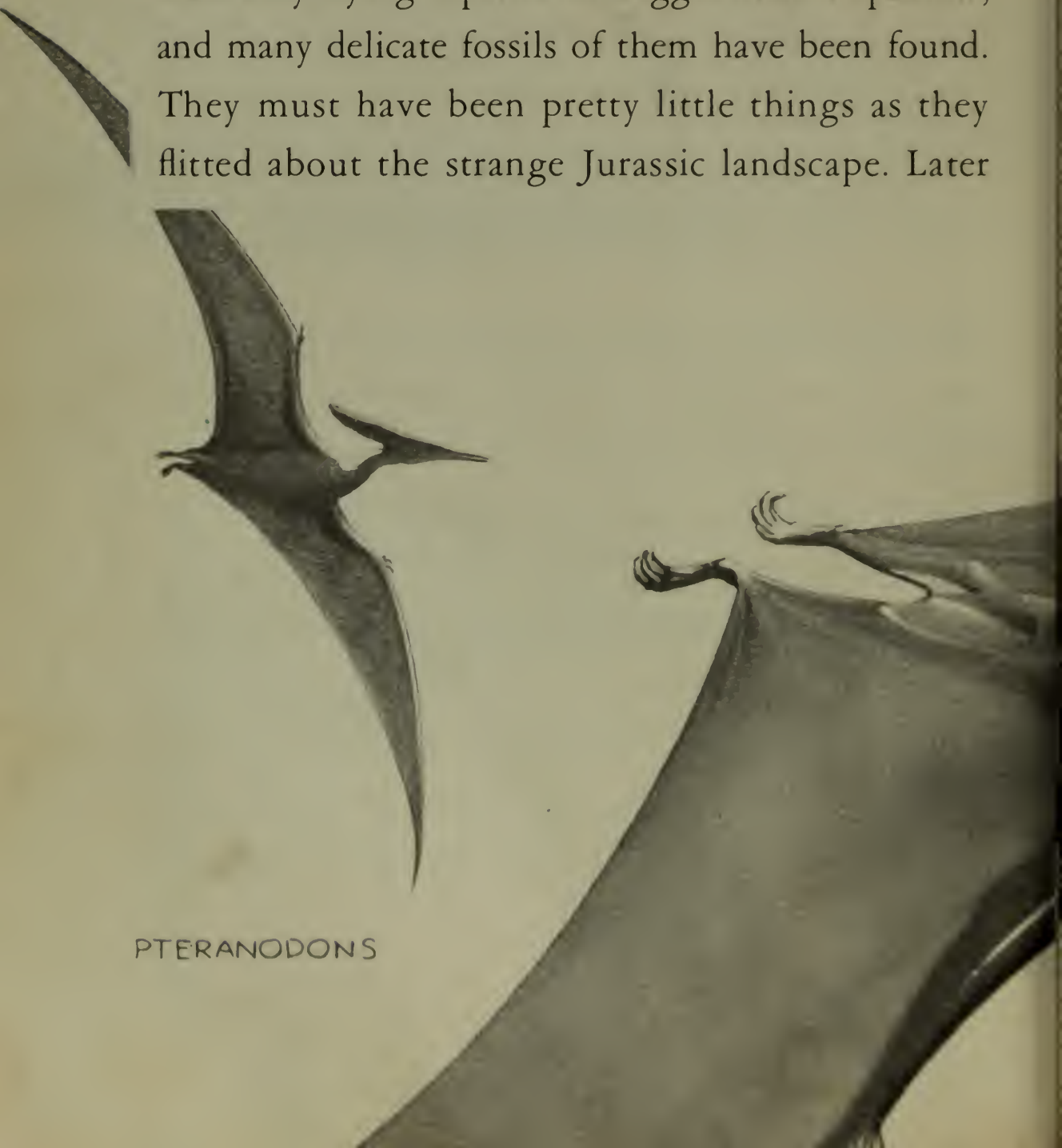


RHAMPHORHYNCHUS



served in many fossils, was stretched between the arm, the amazingly long fourth finger, and the body, forming a wing. The first three fingers were small and ended in hooked claws, which the pterosaur used for hanging on trees and rocks when resting. The fifth finger had disappeared. *Rhamphorhynchus* had a fine set of forward-pointing teeth that must have been useful for catching fish. It probably got its food by skimming over the water and picking up surface-swimming fish, as do the gulls and terns today.

From *Rhamphorhynchus* and its relatives another group of pterosaurs evolved. They were called pterodactyls and had almost no tail at all. At first they were tiny flying reptiles no bigger than a sparrow, and many delicate fossils of them have been found. They must have been pretty little things as they flitted about the strange Jurassic landscape. Later

A detailed black and white illustration of a Pteranodon in flight. The creature is shown from a side profile, with its long, narrow wings fully extended. It has a very long, pointed beak and a small crest on its head. The illustration is positioned on the left side of the page, with its wings and tail extending towards the center. The background is a plain, light color.

PTERANODONS

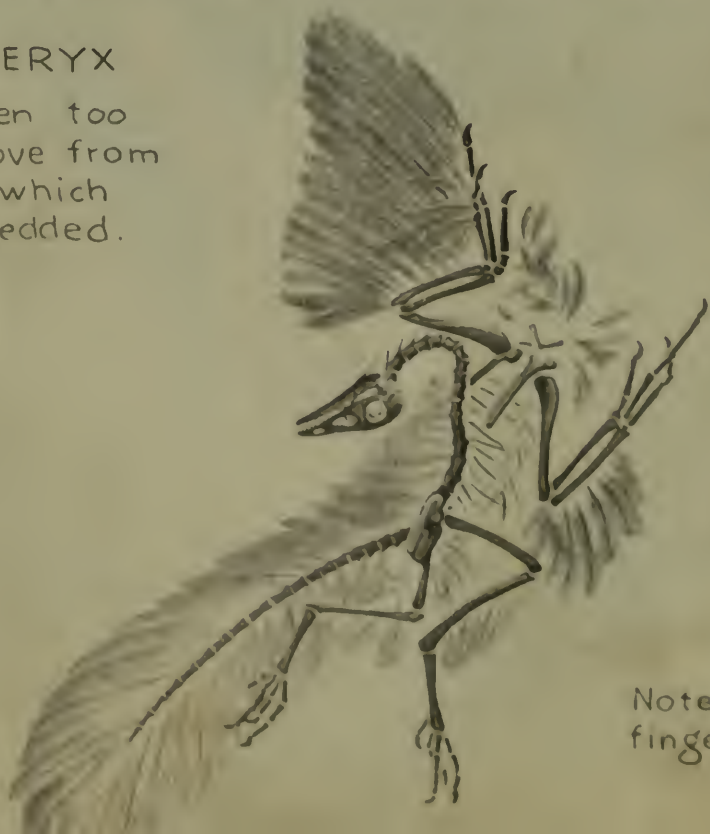
pterodactyls became huge. *Pteranodon* looked like a great beaked flying dragon. Although its body was no bigger than that of a Thanksgiving turkey, its wings measured twenty-five feet from tip to tip! A fossil of this last flying reptile was found in a place in Kansas that was seashore a hundred million years ago.



By the mid-Jurassic period, at the same time that small mammals were evolving from mammal-like reptiles, birds evolved from distant thecodont ancestors. Two fossils of the earliest known birds, Archaeopteryx (ancient winged one) have been found. Its development is actually about halfway between a reptile and a bird. If it were not for the imprint of feathers in the rock, it might have been mistaken for another reptile fossil. Many other adaptations besides feathers made birds better flying animals than pterosaurs. So as birds evolved into many successful species, the pterosaurs finally became extinct.

ARCHAEOPTERYX

Fossils are often too fragile to remove from the stone in which they are embedded.



Note reptile-like teeth, fingers, and tail bone



All the other orders of the ruling reptiles are still represented by *living* animals—crocodiles, sphenodons, lizards, and snakes. The first crocodile that we know of from fossils was *Protosuchus*, whose remains were found in rocks from the Upper Triassic period in Arizona. Three-foot-long *Protosuchus* walked on four legs, but its hind legs were longer than its front legs, as those of crocodiles are today. They are one of the things that show a crocodile's thecodont ancestry. *Protosuchus* was a good runner on land, and



PROTOSUCHUS



it may also have been able to swim, but it was not as well adapted to the water as its descendant, the present-day crocodile.

By Cretaceous times the crocodiles had evolved webbed feet, long powerful jaws, and an armor-plate covering like that of crocodiles and alligators today. Crocodiles and their relations have lived through the years primarily in warm places. When you look at a crocodile or an alligator in a zoo, it might be fun to remember that you are seeing the nearest living relative to a dinosaur.

Still another order of reptiles in this important subclass appeared during the Triassic period. They were the rhynchocephalians, which are represented today by only one living member of their kind, *Sphenodon*. But the rhynchocephalians are only *just* represented. *Sphenodon*, or the tuatara, as it is commonly called, lives only on a few islands off the coast of New Zealand. Due to its isolation from the rest of the world, *Sphenodon* is almost unchanged from a fossilized rhynchocephalian, its ancestor of one hundred and forty million years ago. This lonely little remnant of a once plentiful and widespread group of ancient reptiles inhabited all of New Zealand up to fairly recent times. With the coming of man, however, *Sphenodon* was almost wiped out. Just in time people realized what was happening, and this little reptile is now as carefully protected from harm as any animal in the world. You need a permit from the New Zealand government before you can even set foot on one of *Sphenodon's* islands.



SPHENODON

The lizards and snakes are the most plentiful descendants of the ruling reptiles still alive. There are only twenty-five species of crocodiles, one species of rhynchocephalian, and four hundred species of turtles, but there are almost four thousand species of lizards and snakes.

The first lizards appeared in the Triassic period. Most of them looked something like those that live today. But by late Cretaceous times certain lizards



MOSASAUR

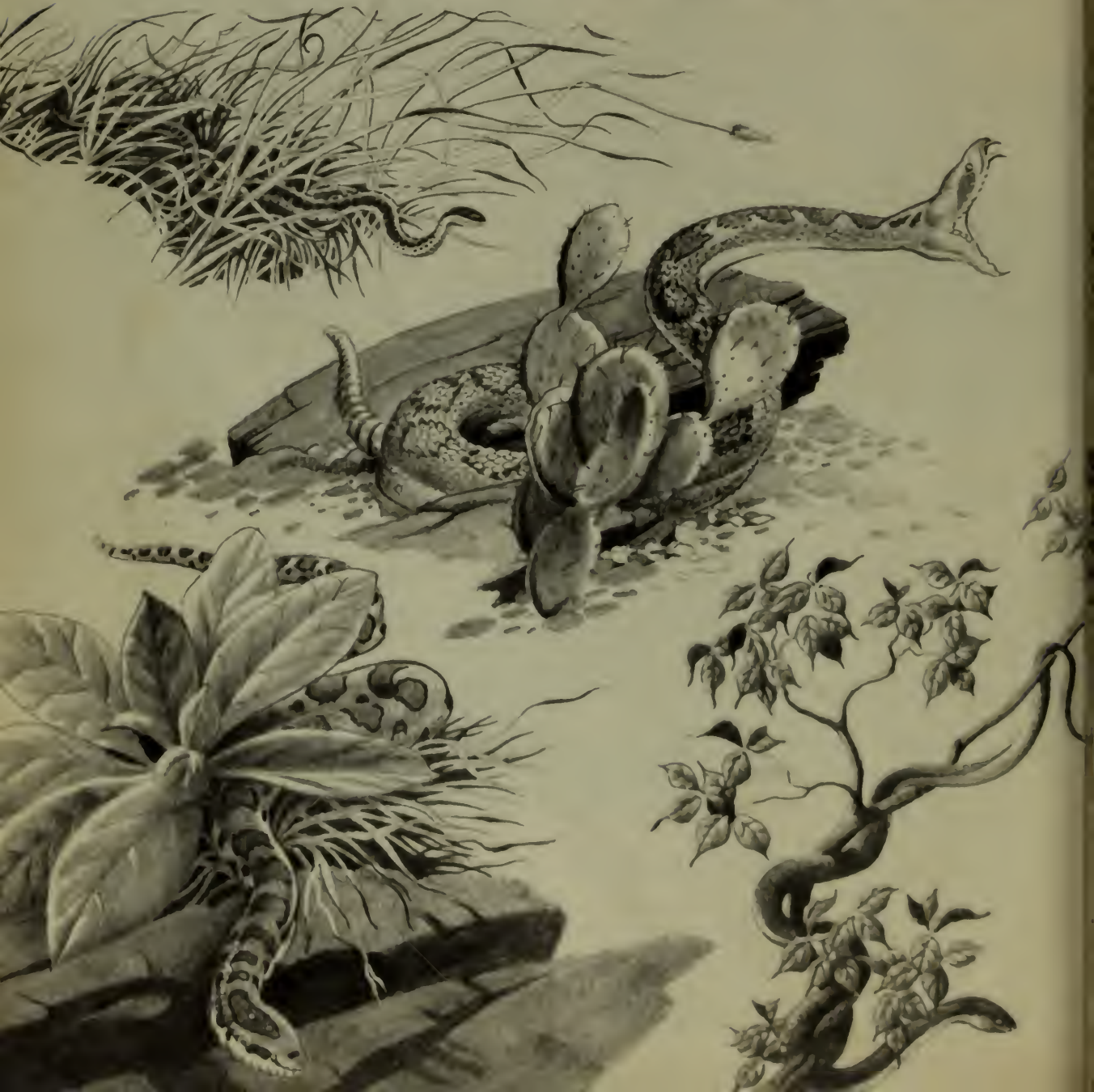


had become sea monsters thirty feet long. They were the mosasaurs. Still later, when mosasaurs and many of the other reptiles had become extinct, lizards began to spread and become numerous. Today many are colorful and beautiful. Some are small like the chameleon, only as big as your thumb, and others are creatures ten feet long. Big or little, most lizards live quiet and inconspicuous lives. Perhaps this is one of the secrets of their long survival.

COLLARED LIZARD



Snakes appeared during the Cretaceous period. They were the last reptiles to develop on the reptile family tree, and they evolved from lizards. They got along very well without the legs their ancestors once had, for they can go fast enough to suit their





way of life by simply wriggling. Legs would only be a handicap in the grasses, cracks, and tight holes where snakes often live. The skeleton of the python still has hipbones, and it is one proof that snake ancestors once had legs.



The history of the reptiles shows that animals change a great deal over long, long stretches of geologic time. The earth changes too. Mountains rise, are eroded away by rain and wind, and rise again. Great *Brontosaurus* roamed where the Rocky Mountains now stand. In that time, however, this land looked like the land of the Mississippi River delta today. Sometimes these things happen quickly, as when a violent volcano builds a mountain in a few years. Sometimes they happen slowly as the earth's surface folds and buckles, creating great mountain ranges, or sinks, letting the sea flood over it. Most of our Midwestern states, from Texas to Canada, were once under water, and we have found many fossils of sea animals there.





Shallow Sea

Land

Land

Deep Sea

Deep Sea

Shallow Sea

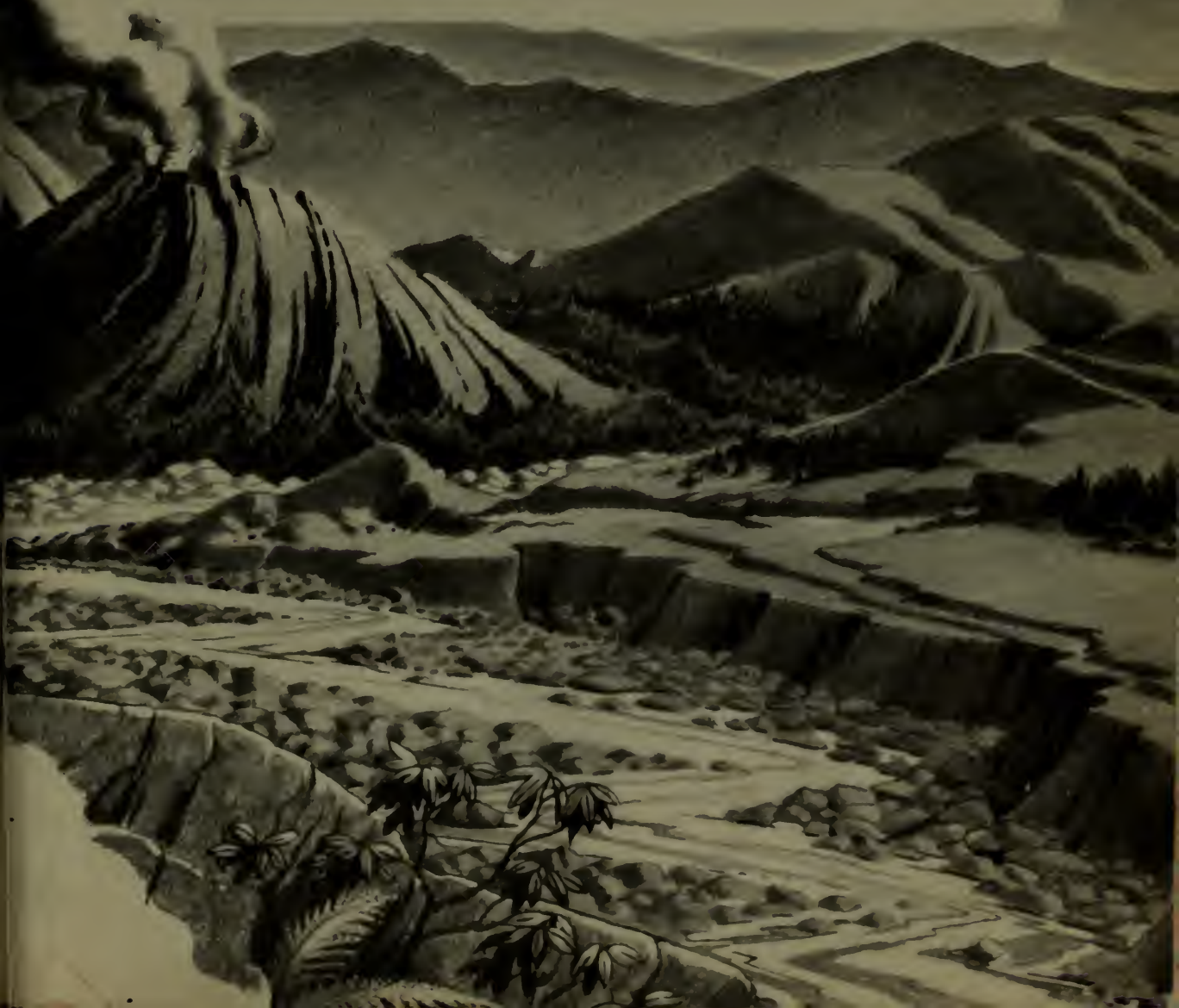
NORTH AMERICA DURING THE JURASSIC
150 MILLION YEARS AGO



Many times animals do not become adapted to changing conditions in their surroundings. Then their present adaptations no longer fit them for their life, and they become extinct.

The last part of the Cretaceous period was a time of tremendous geological change. New lands were rising slowly out of the seas. Inland seas and swamps were disappearing. Modern flowering plants and trees had evolved and were becoming varied. The climate was becoming varied too, instead of being much the same all over the world. The dinosaurs reached the high point in their development at this time.

Marine reptiles were plentiful, and pterosaurs glided through Cretaceous skies. Bony fishes of the modern kind had spread through rivers, lakes, and oceans. Birds were also plentiful and varied. Even the small mammals of the time had started to spread. But the Age of Mammals was still to come. Reptiles of all imaginable kinds still lived in ways that later mammals would live in.



At the end of the Cretaceous period, which was also the end of the whole Mesozoic era, something tremendous happened. The great dinosaurs, the large sea reptiles, the pterosaurs, and most of the rest of the multitude of reptile species disappeared. Of course, they did not vanish all at once, but disappeared gradually through millions of years. Only the turtles, crocodiles, tuatara, lizards, and the snakes survived. What happened?

We are not really sure. The latest methods used to discover the climate of past ages show that the world temperatures in general got colder at the end



The first uplift of the Alps, the Himalayan, Andean, and Rocky Mountain chains took place at the end of the Cretaceous.



of the Cretaceous period. Perhaps unwarmed reptile eggs could not hatch. But there were still many areas which had a tropical climate, and we do not know why at least a few dinosaurs did not survive in these places. We also do not know why the eggs of the reptiles which have survived did not suffer in the same way. Why were only the eggs of the dinosaurs, sea reptiles, and pterosaurs harmed?

We are quite sure that the mammals did not cause the dinosaur extinction by outdoing them. Fossils show that mammals multiplied greatly only *after* most of the reptiles had gone.



There is a theory that dinosaurs just got too big to exist. Perhaps they became so big that they could not find food to support themselves under the new conditions of the Cenozoic era. But some late dinosaurs were not very big. Why didn't they survive?

Perhaps early mammals existed in great numbers, if not in great variety. They may have eaten dinosaur eggs, and their appetites may have made it impossible for dinosaurs to reproduce in large enough numbers to continue their species.

But then what finished the sea reptiles, like the ichthyosaurs, which did not lay eggs? Perhaps the modern fishes outdid the ichthyosaurs.

If the dinosaurs, pterodactyls, and sea reptiles vanished, why didn't the lizards, snakes, turtles, and crocodiles go along with them? They are reptiles too. If world conditions were impossible for the dinosaurs, why were they not impossible for these other cold-blooded animals? Perhaps lizards and snakes hid their eggs better, or perhaps they guarded them better. Some lizard and snake mothers may have kept their young inside their bodies until they were ready to be born, as our familiar garter snakes do today. Or perhaps they survived because they were small enough to burrow below the frost level during the winter, as they still do.

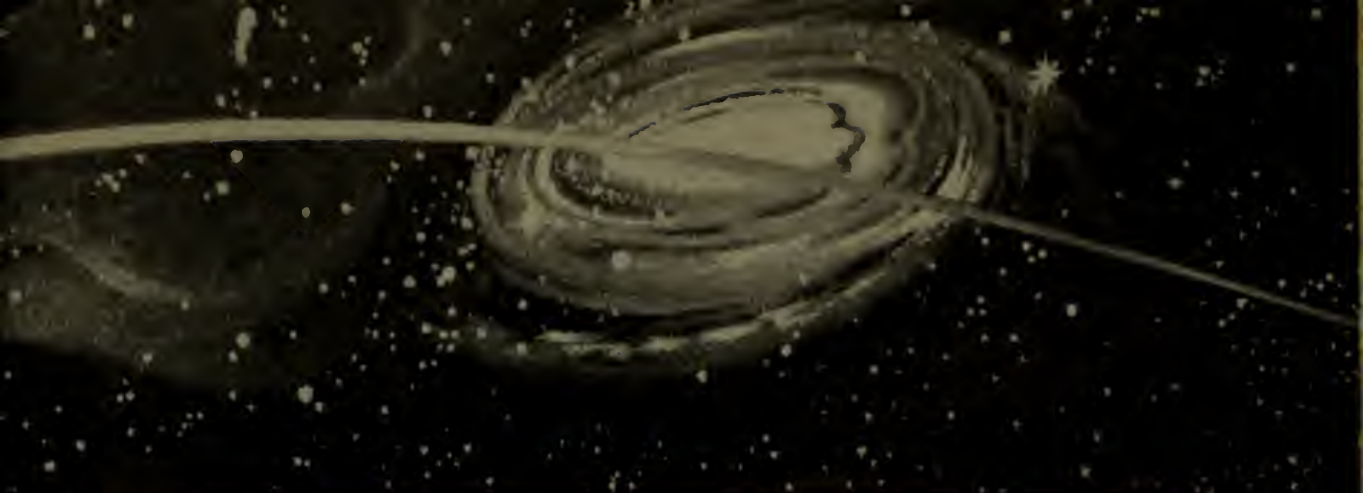


Probably many complicated causes were responsible for the extinction of so many reptiles. Whatever happened, we do know that changing conditions of one kind or another undoubtedly caused the great extinction that marked the end of the Mesozoic era and the start of our own era, the Cenozoic. But no one really knows all the exact answers to why the great Age of Reptiles came to an end.









Human beings are only at the beginning of understanding certain things about life. In these modern days, when we are so near to the conquest of space, we are apt to think that we have become masters of the universe. And yet we still have only little knowledge of how life came about, what makes a living thing work, and how future conditions will affect all living things. We may be very successful at launching spaceships in the near future, but we shall still know little about the men who will be in them. Perhaps some of you will one day help to answer the riddles of life. We need these answers to understand ourselves better, to make our lives richer and fuller, and to help us face the changing conditions of our own future.

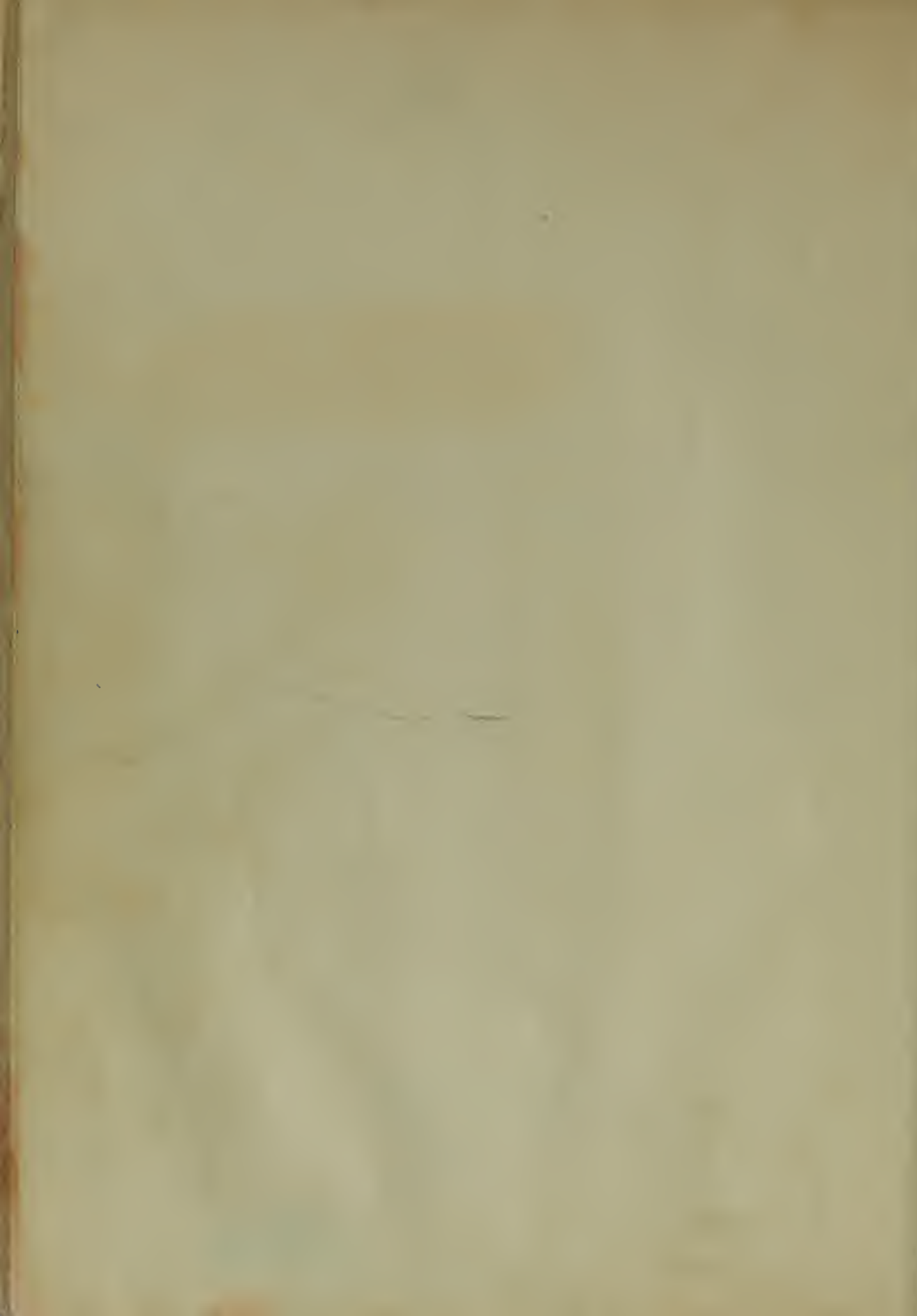
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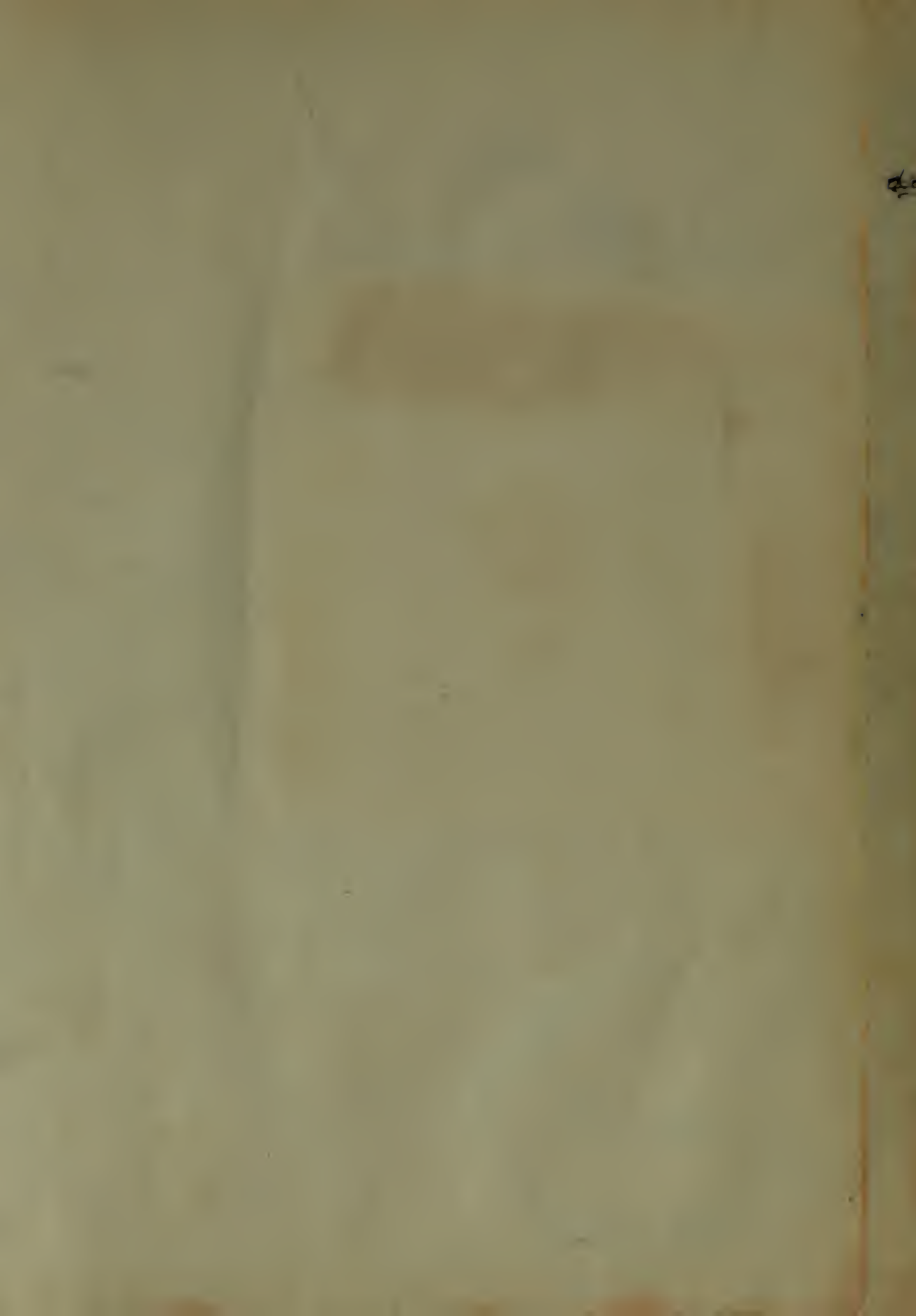
<i>Name</i>	<i>Pronunciation</i>
Allosaurus	ăl' ô sô' rûs
Ankylosaurus	ăng' kǐ lô sô' rûs
Archaeopteryx	ăr' kê ốp' tēr ỉks
Brachiosaurus	brā' kǐ ô sô' rûs
Brontosaurus	brôn' tồ sô' rûs
Cotylosaur	kốt' ỉ lô sôr
Cynognathus	sỉ nốg' nà thũs
Diplodocus	dĩ plöd' ô kũs
Ichthyosaur	ỉk' thĩ ô sôr'
Mosasaur	mō' sả sôr
Nothosaur	nốth' ô sôr
Ornitholestes	ôr' nỉ thô lếs' tēz
Ornithomimus	ôr' nỉ thô mĩ' mũs

Pelycosaur	pěl' ĭ kô sôr
Phytosaur	fĭ' tō sôr
Placodont	plăk' ô dōnt
Plesiosaur	plē' sĭ ô sôr
Pteranodon	tē răn' ô dōn
Pterodactyl	těr ô dăk' tĭl
Pterosaur	těr' ô sôr
Rhamphorhynchus	răm' fô rĭng' kŭs
Rhynchocephalian	rĭng' kô sē fā' lĭ ăn
Sauropterygian	sô rōp' tēr ĭj' ĭ ăn
Sphenodon	sfē' nô dōn
Stegosaurus	stĕg' ô sô' rŭs
Struthiomimus	strōō' thĭ ô mĭ' mŭs
Thecodont	thē' kô dōnt
Theropod	thēr' ô pōd
Therapsid	thē răp' sĭd
Triceratops	trĭ sēr' ă tōps
Tyrannosaurus	tĭ răn' ô sô' rŭs

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